·Brief Report·

Inverted internal limiting membrane flap technique for very large macular hole

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Abstract

• AIM: To assess the anatomical and visual outcome of idiopathic macular holes greater than 1000 μm using the inverted internal limiting membrane flap technique.

• METHODS: This retrospective case series included 5 eyes of 5 patients with idiopathic macular hole with base diameter greater than 1000 μm who underwent inverted internal limiting membrane flap technique along with standard 23G pars plans vitrectomy with posterior hyaloid detachment and fluid gas exchange with 12%–14% perfluoropropane (C3F8). Preoperative and postoperative visual acuity and spectral domain optical coherence tomography images were evaluated. The main outcome measures were visual outcome and macular hole closure.

• RESULTS: Mean age was 63.2±8.4y with all 5 subjects being females. Mean duration of symptoms was 11±14mo with a mean postoperative follow up of 13.2±13mo. The mean base diameter of the macular holes was 1420±84.8 μm (1280–1480 μm). Type 1 closure was achieved in four out of five patients, while one patient had type 2 closure using the inverted internal limiting membrane (ILM) flap technique. Median baseline BCVA was 0.79 logMAR (Snellen's equivalent 20/120) and median final BCVA 0.6 logMAR (Snellen´s equivalent 20/80) with mean visual improvement of approximately three lines improvement. No complications related to surgical procedure were noted.

• CONCLUSION: The inverted internal limiting membrane flap technique may be promising for very large macular holes with high rate of macular closure and good visual outcome.

• **KEYWORDS:** inverted internal limiting membrane flap technique; vitrectomy; macular hole

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INTRODUCTION

Vitrectomy with internal limiting membrane (ILM) peeling is now the gold standard for macular hole surgery, since it was first described by Kelly *et al* [1] and co-workers in 1991, with closure rate ranging from 68 to 98 percent [1-6]. Michalewska *et al* [7] for the first time reported improved postoperative closure rate and visual function with inverted ILM flap technique for idiopathic large macular hole (more than 400 μm). Later, Mahalingam and Sambhav [8] showed successful closure up to 1000 μm with this technique. However, there is little data available on closure rates of very large macular hole particularly above 1000 μm. We studied the postoperative anatomical and visual outcome of idiopathic macular holes with base diameter greater than 1000 μm using inverted ILM flap technique.

SUBJECTS AND METHODS

This was a retrospective study conducted at the Kanuri Santhamma Retina Vitreous Centre, LV Prasad Eye Hospital, Hyderabad, India. Institute Ethics Committee approval was obtained. The study adhered to the tenets of the Declaration of Helsinki. Medical records of patients who underwent surgery for macular hole repair with inverted ILM flap technique were reviewed. We included eyes with idiopathic macular hole which underwent inverted ILM flap technique for idiopathic macular hole repair with availability of pre- and post-surgery spectral-domain optical coherence tomography (SD-OCT) images and a minimum follow up of 6mo. Exclusion criteria included unavailability or poor quality of SD-OCT scans, eyes with macular hole secondary to trauma, diabetic macular edema or any other cause, any other associated ocular disease.

All patients underwent a comprehensive preoperative and postoperative ophthalmic examination including measurement of best-corrected visual acuity (BCVA) using the 4 m Snellens acuity chart (converted into logMAR for statistical analysis), intraocular pressure (IOP) by Goldmann applanation tonometry, slit-lamp biomicroscopy and dilated fundus examination with indirect ophthalmoscopy.

Table 1 Demographic and clinical profile of the patients

No.	Age /sex	Eye	Duration of symptoms (mo)	Preop. BCVA	Preop. base diameter on OCT (μm)	Preop. minimum diameter on OCT (μm)	Type of closure	BCVA last follow up (mo)	Total postop. follow up (mo)
1	71/F	Right	5	20/100	1280	627	1	20/40	12
2	62/F	Right	6	20/125	1480	612	1	20/100	6
3	66/F	Left	36	20/800	1408	709	2	20/160	6
4	58/F	Right	4	20/120	1452	586	1	20/80	6
5	59/F	Right	4	20/200	1388	594	1	20/63	36

Surgical Technique All five patients underwent standard 23G pars plans vitrectomy (PPV) with posterior hyaloid detachment. Each of them was informed about the risks and benefits of the surgery, and a written informed consent was obtained. Brilliant blue dye (0.05% solution of brilliant blue for 1min) was used for ILM staining. Inverted ILM peeling technique described by Michalewska *et al* [7] was adopted. The ILM peeling was done using pinch and grasp technique up to approximately 2 disc diameters around the macular hole. Edges of the ILM were trimmed with cutter and the remnant was then inverted to cover the macular hole[2,5]. Fluid gas exchange with 12%-14% perfluoropropane (C3F8) was performed.

Postoperative Evaluation The patients were advised face down position for 1wk postoperatively starting from the day of surgery. Follow up was done on 1d, 1wk, 1, 6mo and then as and when basis post-operatively.

Spectral -domain Optical Coherence Tomography Imaging OCT examination was performed before and after surgery in all the eyes using commercially available SD-OCT (OCT4000; Cirrus HD-OCT, Carl Zeiss Meditec Inc., Dublin, California, USA) to confirm whether the macular hole was closed after surgery. High definition (HD) 5 line raster scan passing through the fovea was used for analysis. Measurements were performed by a single observer (Khodani M). Type of closure was defined as type 1 when complete anatomical closure was obtained and type 2 when the base diameter reduced from baseline with flat edges. The main outcome measures were postoperative visual outcome and macular hole closure.

RESULTS

In this retrospective study, total 5 eyes of 5 subjects were included. Mean age was 63.2 ±8.4y (median 62y). All 5 subjects were females. Mean duration of symptoms was 11± 14mo (median 20mo) with a mean postoperative follow up of 13.2 ±13mo (median 21mo). Clinical demographic and clinical profile of the subjects is shown in Table 1.

The mean and median base diameter of the macular holes was 1420±84.8 μm (1280-1480 μm) and 1408 μm respectively. Largest base diameter at baseline was 1480 μm. Improvement of visual acuity was seen in all patients. Mean baseline BCVA was 0.97±0.63 logMAR (Snellen's equivalent 20/200) and mean final BCVA 0.59±0.42 logMAR (Snellen's equivalent 20/80). Median baseline BCVA was 0.79 logMAR (Snellen's equivalent 20/120) and median final BCVA 0.6 logMAR (Snellen's equivalent 20/80). Change in BCVA was 0.38±0.21 logMAR (approximately three lines improvement). There were no intraoperative or post-operative complications.

Spectral -domain Optical Coherence Tomography Analysis Type 1 closure was achieved in 4 out of 5 patients, while 1 patient had type 2 closure using the inverted ILM flap technique. The base diameter reduced from 1408 μm to 172 μm in the patient with type 2 closure. All the eyes with type 1 closure had damaged outer retinal structures at the central 500 μm. Case 1: a 71-year old female presented with dimness of vision in right eye for past 5mo. Examination revealed BCVA of 20/100 and stage 4 idiopathic macular hole with base diameter of 1280 μm on SD-OCT (Figure 1A, 1B). Case 2: a 59-year old female presented with dimness of vision in right eye for past 4mo. Examination revealed BCVA of 20/200 and stage 4 idiopathic macular hole with base diameter of 1388 μm on SD-OCT (Figure 1C, 1D).

DISCUSSION

As proposed before, ILM being a base membrane acts as a scaffold and enables glial cell proliferation to close even large macular holes with tissue over time. It seems that the photoreceptor cells follow gliosis and either reapproximate or regrow over time [1,9]. This leads to visual improvement and normalization of the foveal contour. Surgical outcome of very large idiopathic macular holes varies as closure rate mainly depends on- linear base diameter, presenting visual acuity and duration of symptoms[3-4].

In a landmark study, Michalewska *et al* [7] reported that inverted ILM flap technique prevents the postoperative flat-open appearance of a macular hole and improves both the functional and anatomic outcomes of vitrectomy for macular holes with a diameter greater than 400 μm [3,7]. Subsequently, Kuriyama *et al* [10] reported inverted ILM flap technique as a preferable adjuvant to the treatment of large macular hole in high myopia with or without retinal detachment. Mahalingam and Sambhav [8] also demonstrated successful closure of large macular holes in 5 patients with mean base diameter of 811.4 (728-995) μm with improved

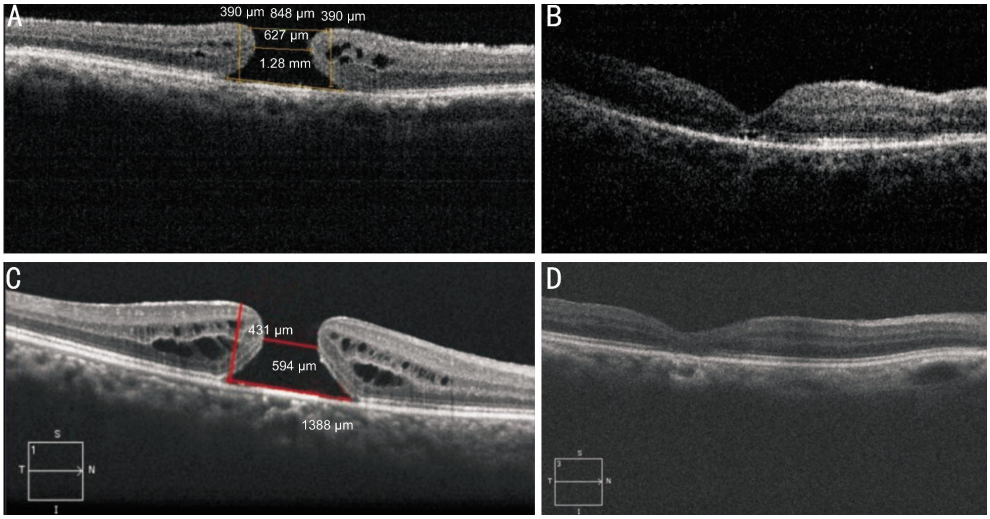

Figure 1 Spectral-domain optical coherence tomography (SD-OCT) of representative cases A: Preoperative SD- OCT image at baseline 1y; B: Postoperative SD- OCT image at 1y follow up; C: Preoperative SD-OCT image at baseline 3y; D: Postoperative SD-OCT image at 3y follow up. Postoperative images of both the cases show discontinuity in outer retinal structures.

visual outcome. Similarly in our study of hole larger than 1000 μm, complete anatomical closure with restoration of foveal contour was obtained in four out of 5 patients at 1mo, which remained consistent up to last follow up. All patients had statistically significant improvement in visual acuity from baseline 0.97±0.63 logMAR to 0.59±0.42 logMAR at last follow up. One eye that showed type 2 closure had duration of symptoms for over 36mo and had a poor visual acuity of 20/800 to begin with. However, it showed type 2 closure with dramatic improvement in vision and reduction in macular hole base diameter from 1408 μm to 172 μm and flat bottom edges measured at one month with inverted ILM flap technique.

Though, type 1 closure was noted in 4 eyes in our series, the outer retinal structures inclusive of inner-segment/outer segment junction and external limiting membrane were disrupted in central 500 μm. We propose the cause of this discontinuity as the large size of the hole. In spite of this, in view of visual improvement after surgery, we would recommend inverted technique for large macular holes repair (larger than 1000 μm).

In conclusion, our study showed improved visual outcome and successful anatomical closure of macular hole larger than 1000 μm, which would otherwise be left untreated or might have resulted in poor anatomical closure with standard technique. Hence, inverted ILM flap technique can be a preferred adjunct to the standard surgical technique for very large idiopathic macular hole. But, a larger study group and longer follow-up period is required to further evaluate this method.

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Conflicts of Interest: Khodani M, None; **Bansal P,** None; **Narayanan R,** None; **Chhablani J,** None.

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