



## EVALUATION OF VISUAL OUTCOME AFTER MACULAR HOLE SURGERY BY INVERTED INTERNAL LIMITING MEMBRANE PEELING TECHNIQUE

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### ABSTRACT

**Background-** Michalewska et al. in 2010 suggested inverted ILM flap technique for management of large macular holes. The present study was conducted to evaluate the visual outcome after macular hole surgery by the inverted internal limiting membrane peeling technique. **Methodology-** The present study was conducted as a prospective observational study at a tertiary eye care center, Bhopal, Madhya Pradesh on patients presenting with macular hole. Their sociodemographic details were obtained including age and sex and entered in proforma. Clinical history regarding mode of presentation, eye involved, comorbid condition, etc. was documented. All the patients were then subjected to detailed ocular examination. Their visual acuity was noted preoperatively. Following this, the patients were subjected to surgery via the inverted ILM peeling technique. Visual acuity was assessed postoperatively and improvement in visual acuity postoperatively was noted. **Results-** PPV with inverted ILM peeling with C3F8 with endolaser was the most common procedure done. Visual acuity improved significantly postoperatively following the procedure. **Conclusions-** Inverted ILM peeling flap technique is effective in management of macular holes irrespective of their size and grades. ILM flap technique helps in significant improvement in visual acuity. A large prospective multicentric study with longer follow up duration is recommended to confirm the long-term efficacy of inverted ILM flap technique.

**KEYWORDS :** inverted ILM flap technique, large macular hole,

### INTRODUCTION

An anatomical defect in the fovea of the retina is a macular hole and is characterized by visual impairment.<sup>[1]</sup> Though the pathogenesis of the macular hole is not understood fully, it is postulated to be multifactorial. Inward traction of the macula is the pathogenesis in the majority of cases, which is attributed to abnormal premacular vitreous cortex adhesion, myopic macular hole or thickening of epiretinal membrane or internal limiting membrane (ILM). Apart from this, posterior staphyloma associated with external traction is also one of the factor linked with macular holes<sup>[2,3]</sup> Till 1991, the management of macular hole was associated with poor visual outcomes. However, introduction of pars plana vitrectomy for the management of macular holes in 1991 by Kelly and Wendel improved the visual prognosis in such cases, but still, the outcome was suboptimal.<sup>[4]</sup> Eckardt et al<sup>[5]</sup> introduced the technique of internal limiting membrane peeling (ILM peeling), which improved the visual prognosis to 98% in case of small macular hole, but the utility remained low in case of macular hole of larger than 400  $\mu\text{m}$ , ranging from 56% to 85%.<sup>[5,6]</sup> Large macular hole managed using conventional ILM peeling have tendency of flat open closure pattern or a W shaped pattern reflecting lack of neurosensory retina in the hole.<sup>[7]</sup> Though this method was helpful in achieving anatomical success, but visual success was typically poor as compared to U or V pattern closures i.e. type 1 closure (corresponding to neurosensory retina).<sup>[8]</sup>

Later, a novel technique was suggested by Michalewska et al. in 2010, which was termed inverted ILM flap technique.<sup>[9]</sup> This surgical technique requires peeling of the internal limiting membrane incompletely from the retina as its edges are left attached to the macular hole, and the membrane is then inverted to cover the macular hole. This method improved the success rate in terms of anatomical as well as visual outcome by 98% for large macular holes.<sup>[9,10]</sup> Previous studies have documented the high success rate of inverted ILM technique as compared to ILM peeling.<sup>[10,11]</sup> In contrast few studies suggest ILM peeling and inverted ILM flap to be equivalent or ILM peeling to be superior.<sup>[12,13]</sup> However, majority of previous studies have been done in Western population, data regarding the utility of this technique in Indian population is scarce. The present study was therefore conducted at our centre to evaluate the visual outcome after macular hole surgery by inverted internal limiting membrane peeling technique.

### METHODOLOGY

The present study was conducted as prospective observational study at ASG Eye hospital, Bhopal, Madhya Pradesh on patients presenting with macular hole scheduled for surgery during the study period of 3 months i.e. from 1st December 2021 to 28th February 2022. All the patients diagnosed with macular hole and willing to undergo surgery were included in the study whereas patients unfit for surgery or not willing to participate in the study were excluded.

After obtaining ethical clearance from institute's ethical committee, all the patients fulfilling inclusion criteria were enrolled in the study. Their sociodemographic details were obtained including age and sex and entered in proforma. Clinical history regarding mode of presentation, eye involved, comorbid condition etc. was documented. All the patients were then subjected to detailed ocular examination. Their visual acuity was noted preoperatively. Following this, the patients were subjected to surgery via inverted ILM peeling technique.<sup>[9]</sup>

### Surgical technique

Inverted ILM peeling technique was used for surgical management of patients with macular hole, the ILM peeling was done but flap was not removed entirely from the retina; edges of the flap were left intact. In case of cataract, phacoemulsification with PCIOL placement was done initially followed by MH surgery. Over the macular area, a small amount of perfluorocarbon liquid was introduced to place the flap and the flap was then inverted over the macular hole with the help of silicone cannula. Fluid-air exchange was done initially to remove all the fluid before removing the central perfluoro-n-octane to avoid movement of the flap. Following this, the placement of flap was confirmed and stained with brilliant blue G, to apply gas tamponade (10% C3F8). Patients were encouraged to maintain the prone position strictly for next 5 days after surgery.

Visual acuity was assessed postoperatively and improvement in visual acuity postoperatively was noted.

### Statistical Analysis

Data was compiled using MsExcel and analysed using IBM SPSS software version 20. Categorical variables were expressed as frequency and proportion whereas continuous variables were expressed as mean and standard deviation. Improvement in visual acuity postoperatively as compared to preoperative value using McNemar chi square test. P value less than 0.05 was considered statistically significant.

### RESULTS

The present study was conducted on a total of 19 cases who were diagnosed with macular hole. Mean age of the patients was 66.58 $\pm$ 7.14 years and female predominance was observed with male: female ratio of 0.58:1. Majority of patients had stage III macular hole (47.4%), followed by 36.8% cases with stage IV macular hole. All the patients had diminished visual acuity at baseline, of them, 10.5% cases had blindness (visual acuity of <3/60). (Table 1)

**Table 1- Distribution according to baseline variables**

|                     | (n=19)           |
|---------------------|------------------|
| Age (Mean $\pm$ SD) | 66.58 $\pm$ 7.14 |
| Sex [n (%)]         |                  |
| Male                | 7 (36.8%)        |
| Female              | 12 (63.2%)       |

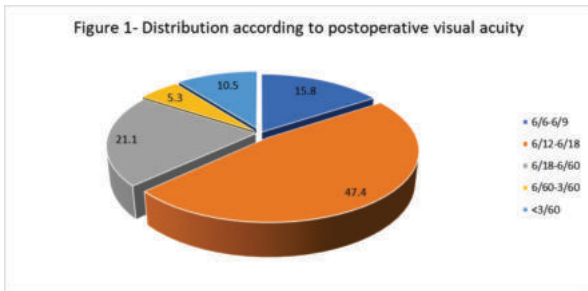
|   |            |
|---|------------|
| Eye [n (%)]                             |            |
| Right                                   | 9 (47.4%)  |
| Left                                    | 10 (52.6%) |
| Diagnosis [n (%)]                       |            |
| Stage II macular hole                   | 2 (10.5%)  |
| Stage III macular hole                  | 9 (47.4%)  |
| NS grade II with Stage III macular hole | 1 (5.3)    |
| Stage IV macular hole                   | 7 (36.8%)  |
| Visual acuity [n (%)]                   |            |
| 6/12-6/18                               | 4 (21.1)   |
| 6/18-6/60                               | 11 (57.9)  |
| 6/60-3/60                               | 2 (10.5)   |
| <3/60                                   | 2 (10.5)   |

PPV with inverted ILM peeling with C3F8 with endolaser was most common procedure done in 94.7% cases whereas 5.3% cases required phacoemulsification with PCIOL implantation in addition to above procedure (table 2).

**Table 2- Distribution according to eye involvement and treatment plan**

|  |         |        |           |
|--|---------|--------|-----------|
|  | Right   | Left   | Total     |
| Phacoemulsification+PCIOL implantation + PPV + Inverted ILM Peeling +C3F8 +Endolaser | 0 (0)   | 1 (10) | 1 (5.3)   |
| PPV+ Inverted ILM Peeling+ C3F8 +Endolaser   | 9 (100) | 9 (90) | 18 (94.7) |

Following the procedure, visual acuity improved to 6/6 to 6/9 in 15.8% cases whereas 47.4% cases had visual acuity in the range of 6/12 to 6/18 and blindness was present in 5.3% cases (figure 1).



**Figure 1- Distribution according to postoperative visual acuity**

Visual acuity improved significantly postoperatively following the procedure (table 3).

**Table 3- Improvement in visual acuity postoperatively**

| Visual acuity | Pre-operatively | Postoperatively |
|---------------|-----------------|-----------------|
| 6/6-6/9       | 0 (0)           | 3 (15.8)        |
| 6/12-6/18     | 4 (21.1)        | 9 (47.4)        |
| 6/18-6/60     | 11 (57.9)       | 4 (21.1)        |
| 6/60-3/60     | 2 (10.5)        | 1 (5.3)         |
| <3/60         | 2 (10.5)        | 2 (10.5)        |
| P value       | 0.001           |                 |

**DISCUSSION**

We conducted this study to assess the visual outcome following vitrectomy with inverted ILM technique. This technique was first described by Michalewska et al for management of large macular holes, and this technique is associated with superior functional and anatomical outcome.<sup>[9]</sup> In our study, 19 cases with macular hole were enrolled and were treated using with inverted ILM peeling with C3F8 with endolaser. Patients with cataract were also subjected to phacoemulsification along with PCIOL placement in addition to the above-mentioned procedure. We assessed only the functional outcome in terms of improvement in visual acuity following the procedure as compared to their baseline visual acuity.

In present study, surgical management of patients with macular hole using inverted ILM technique was helpful in significantly improving visual outcome postoperatively as compared to preoperative visual acuity. The exact mechanism of inverted ILM flap technique is not clearly understood, but histopathologic study highlighted that ILM flap provide a base which act as a scaffold for gliosis and by its sealing action, the flap secludes the communication between the subretinal space and vitreous. Thereby creating a closed compartment which

enables the RPE to effectively pump out the retinal fluid and preventing the seepage of fluid preventing further seepage of fluid and keeping the hole dry.<sup>[14]</sup> An experimental study proved that ILM enhances the proliferation as well as migration of Müller cells in vitro.<sup>[15]</sup> Apart from this, the growth factors especially neurotrophic factors and basic fibroblast growth factor (bFGF) retained on the surface of the flap further stimulate the retinal cells improving the functional as well as anatomical outcome.<sup>[15]</sup>

Our study findings were concordant with the findings of Narayanan et al in which the authors documented significant improvement in visual acuity from 1.13±0.66 at baseline to 0.77±0.30 6 months post inverted ILM flap technique (p<0.05).<sup>[16]</sup> Similarly, Kim et al also reported significant improvement in visual acuity from logMar 0.67 preoperatively to logMar0.21 at 6 months postoperatively (p < 0.001), however, they documented visual outcome to be similar between patients using ILM peeling technique and ILM inverted flap technique.<sup>[17]</sup> Bleidifel et al also reported significant long term improvement of visual acuity following inverted ILM flap technique.<sup>[18]</sup>

The technique is associated with certain technical difficulties depending upon the skills of treating surgeon. First, it is important to ensure the attachment of the flap to the anatomical structure and prevent its detachment from the macula. Second, it is essential to ensure that flap remains inverted till last stage of surgery or atleast till before fluid-air exchange. Also, the fluid air exchange must be as gentle as possible with minimal infusion pressure and low pressure while aspiration of fluid.<sup>[19]</sup>

Our study had certain limitations, first, sample size was very small questioning the generalizability of the study findings and anatomical outcome could not be assessed due to resource constraints, only functional outcome could be assessed, which might be proxy to improved anatomical outcome. Also, there was no comparison group further limiting our study findings.

**CONCLUSIONS**

Inverted ILM peeling flap technique is effective in management of macular holes irrespective of their size and grades. ILM flap technique helps in significant improvement in visual acuity. A large prospective multicentric study with longer follow up duration is recommended to confirm the long-term efficacy of inverted ILM flap technique.

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