Original Article

Surgeon's perceptions and preferences in the management of idiopathic macular hole

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Purpose: The management of idiopathic macular holes (iMH) has evolved over time with various modifications in surgical approach. The study aimed to survey the surgeons' preferences in the management of iMH in current times. **Design:** Cross-sectional descriptive survey. **Methods:** A 12-item questionnaire addressing the key aspects of iMH management was sent, between October 2022 to November 2022, by personal correspondence to 104 vitreoretinal specialists, actively practicing and performing iMH surgeries at various institutes in India. The responses were gathered till January 2023 and analyzed as per appropriate statistical methods. **Results:** Ninety-one retina specialists responded to the survey (response rate of 87.5%) with a median annual surgical load of 30 cases (range: 5–150). Most respondents had similar views on patient selection, combined phaco-vitrectomy, internal limiting membrane (ILM) staining, ILM peel initiation and propagation, tamponade, postoperative positioning, and prognostic factors. The preferred approach for peel initiation was "pinch and peel," but "scrape and peel" was equally recommended for beginners. Most respondents considered iMH >600 microns in size as large and used additional surgical maneuvers for large and failed cases such as ILM flap, large flap, macular detachment, platelet-rich plasma application, and amniotic membrane graft. The three most important visual prognostic factors were duration, preoperative vision, and MH size. **Conclusions:** The practice of surveyed surgeons performing iMH surgery was uniform in several aspects. There is a need to create consensus on the preferred ILM peel technique among trainee surgeons, revisit the iMH size classification, and standardize the surgical approach as per hole size and characteristics.

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The approach to idiopathic macular holes (iMH) has changed in current times with the advances in imaging, vital dyes, and instrumentation. For over 30 years, the Gass classification system has allowed retinal surgeons to prognosticate their cases.[1] Although more physiological, the system considers all MH <400 microns as stage 2 and does not differentiate stage 3 and 4 MH based on size but only on the presence of posterior vitreous detachment (PVD).[1] The International Vitreomacular Traction (IVMT) Study group gave an optical coherence tomography (OCT)-based classification system in 2013,which relied on the minimal linear dimension.[2] While this classification was designed to identify small holes that would benefit from ocriplasmin treatment, it has gained acceptance for the overall assessment and management of iMH.

Pars plana vitrectomy with internal limiting membrane (ILM) peeling and gas tamponade is the conventional treatment for idiopathic macular holes. Although the treatment is standard, there exist various modifications in the surgical approach, maneuver, and postoperative care depending upon the surgeon's preference.

With the reported variations in the success rate of MH surgery based on IVMT study group classification and adjunctive measures being adopted to increase the chance of hole closure in large MH,[3,4] surgeons are now considering 600 microns as the cutoff for large MH as only this cohort of cases seems to have lesser closure rates and visual gains.[5–7]

Various prognostic factors have been assessed for hole closure and visual gains.[6,8,9] The results have been heterogeneous, which has led to a lack of consensus on certain aspects of MH surgery, such as the need for surgery in elderly, one-eyed patients, chronic MH with duration >1 year,

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flat-edged MH with already detached posterior hyaloid, whether to combine with cataract surgery, characteristics of the peel, type of gas tamponade, prone versus no position, and the duration of prone positioning, if considered.

Only two published studies have surveyed MH surgery practices, one from Europe in 2006[10] and another from the United Kingdom in 2009.[11] These surveys suggested that the practice of vitreoretinal surgeons fell comfortably within the then-existing evidence base for MH surgery. A lot has changed in the understanding, management tools, and postoperative care of MH surgery since then. There is a need to review the current practices to analyze if these are synchronous with the available evidence and this study purports to do the same.

Methods

A cross-sectional observational study was performed constituting a survey addressing the current practice patterns of vitreoretinal surgeons in India on macular hole surgery. The institutional review board approval was obtained. The study adhered to the tenets of the Declaration of Helsinki.

A 12-item questionnaire [Supplemental File 1] was designed in the English language, keeping in mind the key aspects of macular hole surgery where inter-surgeon variation is more likely to be present. Most of the questions were close-ended with options to choose and only a few questions required descriptive answers. All 12 questions were optional to answer.

The questionnaire was sent by personal correspondence (email) to 104 vitreoretinal specialists, actively practicing and performing iMH surgeries at various institutes across the country between October 2022 to November 2022, who then returned their responses on the same platform. A reminder was sent to those who had not responded by the end of December 2022.

The responses were received till January 2023, and the data were exported to an Excel sheet. Statistical analysis was performed using the SPSS 23.0 software. The response to individual questions was analyzed for the whole cohort. The analyses of variables with continuous data were performed as mean (with standard deviation) and median (with the range), while the categorical data were expressed as frequency.

Results

Ninety-one retina specialists responded to the survey with a response rate of 87.5% (91/104). The median surgical load of the surgeons was 30 iMH surgeries per year (range: 5–150), and 52.9% (45/85) of the respondents performed more than 20 surgeries per year. Furthermore, 80% (73/91) of the participants were affiliated to tertiary care academic institutions, and the rest were stand-alone practitioners.

The majority of the surgeons (84.3%, 74/89) performed surgery even in elderly patients >75 years, one-eyed patients (78.7%, 70/89), and chronic cases of more than 1-year duration of iMH (71.6%, 63/88). However, 60% (53/89) of surgeons did not perform surgery in flat MH with complete PVD.

Nearly all the surgeons (97.8%, 89/91) preferred brilliant blue G (BBG) dye for staining the ILM, while the remaining two respondents preferred trypan blue dye. In phakic eyes with visually insignificant cataracts, 34.1% (31/91) of surgeons would choose to perform combined cataract surgery with MH surgery, while the rest would prefer to perform cataract surgery on follow-up when required.

The preferred instruments for initiation of ILM peel and creating a flap were ILM forceps (82.2%, 74/90), Finesse loop (11.1%, 10/90), membrane scrapper (4.4%, 4/90), or microvitreoretinal (MVR) blade (2.2%, 2/90). The preferred approach to peeling ILM was "pinch and peel" (80%, 72/90), followed by "scrape and peel" (15.6%, 14/90) and "incise and peel" (3.3%, 3/90). However, the preferred approach recommended for beginners or trainee surgeons was "scrape and peel" (50.6%, 40/79), followed by "pinch and peel" (40.5%, 32/79) and "incise and peel" (6.3%, 5/79).

The preferred distance to initiate peel was 2 disc-diameter (DD) from the MH (52.9%, 46/87), followed by 1 DD (34.5%, 30/87). Furthermore, 12.6% of respondents (11/87) chose variable distance depending on the individual case profile. While the majority did not prefer any quadrant to initiate the peel, 43.7% (38/87) of respondents preferred a fixed area to initiate the peel. Of these 38 respondents, 18 preferred the inferotemporal quadrant to initiate the peel. Nearly all the respondents (97.1%, 68/70) initiated peel away from the blood vessels. The average number of attempts before achieving a satisfactory ILM fracture was 1–2 in 60.5% (52/86) and >2 in 39.5% (34/86) respondents.

Most surgeons did not consider massaging the hole edges (80.7%, 67/82) or draining through the MH (75.9%, 63/83). The preferred vitreous substitute for tamponade was sulfur hexafluoride (SF6) gas (52.7%, 48/90), followed by perfluoropropane (C3F8) gas (41.8%, 38/90) and air (4.4%, 4/90). Postoperative prone position was recommended for 3–7 days by the majority (89%, 81/91), followed by 1 day (8.8%, 8/91) and 6 hours (2.2%, 2/91).

Many respondents considered MH as large when the minimum linear dimension on OCT was >600 microns (42.2%, 38/90). In addition, 31.1% of surgeons (28/910) considered MH >800 microns as large, while only 18.9% (17/90) considered it large if the size was above 400 microns. Four surgeons considered >1000 microns as the definition for large MH. The preferred approaches in large MH were classic inverted ILM flap (48.9%, 44/90), multilayer flap (26.7%, 24/90), temporal flap (11.1%, 10/90), and traditional ILM peel (8.9%, 8/90). The other responses obtained were traditional ILM peel with massage of MH edge, temporal large rhexis, radial ILM peel, and multilayer flap with application of platelet-rich plasma (one respondent each).

The approaches preferred in persistent iMH despite surgery with ILM peeling were free ILM flap (49.4%, 44/89), repeat fluid-gas exchange (12.4%, 11/89), autologous retinal graft (6.7%, 6/89), macular detachment and tamponade (3.4%, 3/89), amniotic membrane graft (AMG, 2.2%, 2/89), platelet rich plasma application (1), and temporal large rhexis (1). Four surgeons considered AMG, and one considered lens capsule transplant as an additional but not preferred option for failed surgery. Furthermore, 24.7% of surgeons (22/89) did not consider further intervention in failed cases.

Lastly, the three most important prognostic factors for visual outcomes after MH surgery (in order of importance)

as perceived by survey participants were the duration of MH (46.2%, 42/91), preoperative vision (40.4%, 36/91), and MH size (37.5%, 33/91). OCT indices, status of PVD, size of peel, type of tamponade, and compliance to positioning were not considered among the three most important prognostic factors by most surgeons.

Discussion

The treatment for idiopathic MH is vitrectomy, ILM peeling, and gas tamponade. However, there exist different views on individual aspects of the surgery, and this study assessed the current practices in India. The survey included responses from vitreoretinal surgeons with good surgical experience and workload.

Nearly 85% of surgeons would operate even on elderly patients >75 years. MH surgery can lead to significant improvement in the quality of life in elderly patients.[12] Therefore, old age may not be considered a criterion to recommend against MH surgery. In the current times, the improvements in microsurgical techniques have made vitrectomy and ILM peeling a safe procedure. This could be the reason that nearly 80% of the surgeons operated on one-eyed patients as well.

Chronic iMH has been described variably as MH with a duration of more than 6 months, 1 year, or 2 years.[13–16] The outcome studies in chronic iMH, which date back to the 1990s, have shown MH closure rates varying from 63% to 95%.[13–16] While some authors have cautioned against surgery in chronic MH, most studies have reported an average of 2–3 Snellen line improvement.[13,14,16] Chronic iMH may thus benefit from surgery, and some useful vision could be obtained, and this would be the reason why nearly three-fourths of the respondents in the survey would operate on chronic iMH cases.

Almost all surgeons used BBG dye for staining the ILM. Compared to indocyanine green, newer dyes such as BBG, trypan blue, or a combination of these with polyethylene glycol or deuterium are much safer.[17] While trypan blue also stains epiretinal membranes, BBG is specific for ILM and remains the first choice for ILM staining.[18]

Vitrectomy for MH increases the risk of development and progression of cataract. Only one-third of surgeons performed phaco-vitrectomy in eyes with insignificant cataract. While a combined phaco-vitrectomy will avoid a second surgery, the combined approach may have a higher risk of intraoperative complications such as corneal edema, poor visualization, and iatrogenic retinal injury and postoperative issues such as posterior synechiae formation, high intraocular pressure, unpredictable refractive outcomes, and MH non-closure.[19,20] A recently performed systematic review and meta-analysis found no significant difference in the outcomes and complications between combined and sequential surgery groups.[21] However, most studies included in the meta-analysis were retrospective or low-moderate quality trials.

ILM peel can be initiated by forming a flap with the help of forceps (pinch technique), MVR blade, pick, diamond-dusted membrane scraper, or serrated nitinol loop (Finesse loop).[22] The degree of dissociated optic nerve fiber layer appearance with scrapping ILM is greater than after pinching it.[23] Most of the surgeons in the survey used ILM forceps, and only a few preferred loop or scraper. However, many of them advocated the "scrape-and-peel" technique for beginners as experience and dexterity in hand control are required to avoid pinching the retinal tissue with forceps. For similar safety reasons perhaps, nearly all surgeons preferred initiating the peel away from blood vessels.

Nearly half of the surgeons initiated ILM peel 2 DD away from the MH, and one-fifth of surgeons preferred the inferotemporal quadrant. While there is no standard location to initiate the peel, the ILM is thickest and has maximum rigidity at nearly 1 mm from the foveal center.[24] Therefore, it may be easier and also safer to initiate the peel away from the foveal center.

Massaging the MH edge with a scraper, Finesse loop, or soft-tip cannula and draining through the MH with a soft-tip extrusion cannula have been considered by some authors to mobilize the adjacent retina and assist in hole closure in chronic, large, or persistent MH. In 2007, Alpatov *et al*.[25] described the technique of tapping the MH edges from periphery to center with a vitreal spatula; since then, more surgeons have explored its role either alone[26] or with other adjuvant maneuvers such as macular detachment[27] or drainage through the MH. However, retinal massage has been associated with retinal pigment epitheliopathy, and drainage through MH can also damage the underlying retinal pigment epithelium (RPE) and adjacent photoreceptors.[25,28] Nearly 80% of the surgeons did not consider these techniques in their practice.

The preferred gas for endotamponade was SF6, with C3F8 being a close second option. Gas tamponade helps by reducing the fluid flow across the MH and brings the edges of MH closer by the action of interfacial surface tension. Initially, the choice of gas preferred was C3F8 gas, which would maintain these functions for a longer period and perhaps improve the closure rates, but now there has been a gradual shift to the use of shorter-acting SF6 gas. The understanding behind hole closure has improved, and we now know that factors other than choice of tamponade also play a role, such as type and duration of postoperative posture, fill of gas, chronicity of MH, and retinal compliance. The current evidence is weak and does not support the use of a particular gas.[29]

Conventionally, a prone position is advised for a duration of 3 days–1 week after MH surgery, and this practice was also observed in this survey. There is no definitive evidence regarding the need and duration of prone or face-down positioning (FDP) after MH surgery.[30] However, closure rates and visual gains are better in the subset of large MH (>400 microns) with FDP versus other positions.[30,31] What seems more relevant is the fill of gas; if it is more than 50% fill for a desired duration, then adequate MH tamponade could be achieved with the propped-up position as well.[29] Larger MH may need tamponade for a longer duration (5–7 days) and hence these cases benefit from FDP.[31]

Traditionally, MHs >400 microns in size have been considered as large, and additional maneuvers such as ILM flap and those aimed at improving retinal compliance have been advocated to improve closure rates in this category. In 2013, even the IVMT study group classified MH >400 microns as large.[2] Recently, it has been noted the holes larger than this close to a certain extent without additional maneuvers with comparable visual gains.[5–7] In 2018, the Manchester Large

Macular Hole Study reported MH >650 microns as large as these failed to close or had type 2 closure with only ILM peel.[5] In 2021, the BEAVRS Macular Hole Outcome group suggested using 500 microns as the cutoff for large MH as beyond this the success rate starts to decline.[6] Most recently, the CLOSE study group reported that ILM peel is enough for MH <530 microns, while MH between 535 and 800 microns need ILM flap techniques, and MH >800 microns need more invasive maneuvers such as macular hydrodissection or detachment, amniotic membrane transplant, or retinal autografts.[7]

Along similar lines, most of the surgeons in the survey reported considering MH >600 microns as large, followed by a close second option of >800 microns. In the category of large MH, the respondents preferred inverted or multilayered ILM flaps. The inverted ILM flap technique, originally described by Michalewska *et al*.,[3] provides a higher anatomical closure rate as well as visual gain in large MH than only ILM peel by providing a bridge of glial tissue that contracts and brings the MH edges together.[32] Very large MH require more invasive techniques or a combination of these techniques aimed at increasing retinal compliance (arcade to arcade peel or arcuate temporal retinotomy), freeing the retina from underlying adhesion with RPE (macular hydrodissection or detachment), promoting further glial reaction (platelet-rich plasma or autologous serum application), replacing the dead space with retinal tissue (retinal autografts), and bridging the space with other tissues (amniotic membrane or lens capsule).[4]

For failed, persistent, or recalcitrant cases, all the surgical methods mentioned above for very large MH could be used.[33] However, the more commonly used technique is the free ILM flap. In our study also, the surgeons preferred either free flaps or repeat fluid-air exchange with longer-acting gas tamponade. The visual prognosis in repeat MH surgery tends to remain suboptimal despite anatomical closure.[33] This explains why close to one-fourth of the surgeons in the survey did not consider repeat intervention.

Several factors have been identified as predictive of visual outcomes after successful MH surgery, including preoperative visual acuity, MH duration, age, lens status, MH size, OCT parameters, autofluorescence patterns, type of tamponade, and duration of FDP.[6,8,9,34,35] Among these, the study participants perceived duration of MH, preoperative vision, and MH size as the most important predictors. In 2021, Fallico *et al*.[35] reported symptom duration as the most important predictor, followed by preoperative visual acuity and MH size. These factors indirectly reflect the condition of the external limiting membrane, ellipsoid zone, and interdigitation zone, which are key structures integral to the visual function.

Inherent to most surveys, the current study had limitations of coverage bias, sampling bias, non-response bias, and recall bias of the respondents. The survey does not reflect the practice of all vitreoretinal specialists in the country. Being cross-sectional, the data applies only to the current times as MH surgery practices are continuously evolving. The study surveyed only the surgical approach and not the anatomical and functional outcomes of MH surgery.

Conclusion

This survey revealed the current practice patterns of experienced vitreoretinal surgeons performing MH surgery in India and found them in accordance with the available evidence. There is a need to revisit and reassess the existing classification system for MH size and patient selection criteria, standardize the ILM peel techniques, particularly for beginners, and determine the most beneficial additional surgical maneuvers as per MH size and configuration.

Abbreviations

iMH: idiopathic macular hole; ILM: internal limiting membrane; PVD: posterior vitreous detachment; IVMT: international vitreomacular traction; BBG: brilliant blue G; SF6: sulfur hexafluoride; C3F8: perfluoropropane; AMG: amniotic membrane graft; FDP: face-down positioning; RPE: retinal pigment epithelium; ELM: external limiting membrane; EZ: ellipsoid zone; IZ: interdigitation zone.

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Supplementary Information

This article contains additional online-only material. The following should appear online only: Supplemental File 1.

The supplemental file contains the 12-item questionnaire addressing the key aspects of idiopathic macular hole management that was shared with the survey respondents. Macular Hole Survey Study Group: Alok Sen, Amit Jain, Anand Rajendran, Bibhuti *P* Kashyap, Brijesh Takkar, Chaitra Jayadev, Daraius Shroff, Deependra V Singh, Devesh Kumawat, Dhananjay Shukla, Giridhar Anantharaman, Gopal S Pillai, Guruprasad S Ayachit, Jaya Prakash V, Mahesh *P* Shanmugam, Manish Nagpal, Mayank Bansal, Naresh Babu, Pradeep Kumar, Pradeep Venkatesh, Pramod S Bhende, Raja Narayanan, Rajpal Vohra, Ramandeep Singh, Rohan Chawla, Saurabh Luthra, Saurabh Verma, Shorya Vardhan Azad, Subhendu K Boral, V R Saravanan, Vinod Kumar, Vishal Agrawal, Vishali Gupta, and Vivek Pravin Dave.

Questionnaire

Simple [no ERM] Idiopathic macular hole and ILM peeling

- Tick the appropriate response
- Specify/ describe wherever required

1. Number of macular hole surgeries in 1 year [pre-covid] [range]

2. Do you perform surgeries in the following situations?
    a. Age above 75 years- No/Yes
    b. One eyed patients- No/Yes
    c. Duration of macular hole [well documented] more than 1 year- No/Yes
    d. Flat macular hole [like type 2 closure] with complete PVD- No/Yes

3. What is the preferred dye?
   BBG/ Membrane blue/ ICG/ Tricort/ Trypan blue/ No stain/ others

4. In phakic patients with insignificant cataract do you prefer
    a. combined surgery
    b. sequential surgery

5. Would you recommend
    a. Massage of the hole edges- No/Yes
    b. Draining through the macular hole- No/Yes

6. What is the preferred vitreous substitute?
    a. Air
    b. SF6
    c. C3F8

7. How long is the recommended postoperative positioning?
    a. 6 hours
    b. 1 day
    c. 3-7 days

8. What are the 3 most important visual prognostic factors [in order of importance]-
    a. Duration
    b. Preoperative vision
    c. Size
    d. MH OCT indices
    e. Status of PVD
    f. Size of peel
    g. Type of tamponade
    h. Compliance to positioning

9. With regard to initiation of peel and creating a flap
    a. Preferred choice of instrument
        i. Forceps
        ii. Membrane scrapper
        iii. Finesse loop
        iv. MVR blade
    b. Preferred approach
        i. Pinch and peel
        ii. Scrape and peel
        iii. Incise and peel
    c. What would be the preferred approach recommended for a beginner surgeon- i/ ii/ iii/ others
    d. Preferred location for initiating peel
        i. how many disc areas away from the hole- 1DD/ 2DD/ others
        ii. which quadrant- variable/ fixed- ST/ IT/ IN/ IT/ 6/ 12/ 9/ 3 O'clock
        iii. prefer to initiate peel close to a blood vessel- No/Yes
    e. Average number of approaches [attempts] before achieving a satisfactory ILM fracture [range]

10. What would you consider as a large macular hole [in microns]?
    Above 400µ/ above 600µ/ above 800µ/ others

11. What is the preferred approach in a large macular hole?
    a. Traditional surgery
    b. Classic Inverted ILM flap
    c. Multilayer flap
    d. Temporal flap
    e. Others [please name]

12. What is the preferred approach in failed surgery for macular hole [with ILM peeling]?
    a. No further intervention
    b. Free ILM flap
    c. Macular detachment and tamponade
    d. AMG
    e. Others [please specify]- Repeat FAX/ autologous retinal transplantation/ lens capsule/ platelet rich plasma