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# Observation on the Effect of Internal Limiting Membrane Flipping and Covering Technique in the Treatment of High Myopic Macular Hole

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**Abstract:** *Objective:* To evaluate the effectiveness of the internal limiting membrane (ILM) flipping and covering technique in the treatment of patients with high myopic macular hole (HMMH). *Methods:* One hundred and two patients with HMMH who were admitted to the hospital from June 2019 to June 2024 were selected. The minimum diameter of the macular hole (MH) in all patients was ≤ 500μm. The patients were randomly divided into two groups. The experimental group received 25G pars plana vitrectomy (PPV) combined with ILM flipping and covering technique, while the reference group received PPV combined with ILM peeling. The efficacy indicators and best corrected visual acuity levels were compared between the two groups. *Results:* The MH closure rate and retinal reattachment rate were higher in the experimental group than in the reference group at 3 and 6 months postoperatively ($P<0.05$). The best corrected visual acuity level was higher in the experimental group than in the reference group at 3 and 6 months postoperatively ($P < 0.05$). The Chinese version of the Visual Function-Related Quality of Life Questionnaire-25 (CVRQOL-25) score was higher in the experimental group than in the reference group at 3 and 6 months postoperatively ($P < 0.05$). No serious complications were observed in both groups postoperatively, and there was no difference between the two groups ($P > 0.05$). *Conclusion:* The ILM flipping and covering technique can improve the MH closure rate and retinal reattachment rate in patients with HMMH (diameter ≤ 500μm), enhance the best corrected visual acuity level, and improve the quality of life related to visual function, with fewer postoperative complications.

**Keywords:** Internal limiting membrane flipping; Internal limiting membrane peeling; High myopic macular hole

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## 1. Introduction

HMMH is a common comorbidity for patients with high myopia, and its pathogenesis is complex, involving various factors such as vitreous traction, thinning of the macular retinal area, and axial length extension. Symptoms can include decreased vision, floaters, or distorted vision, which can long-term affect patients' daily lives [1]. PPV combined with internal limiting membrane peeling is a commonly used surgical method for this disease, which can significantly relieve disease symptoms, but it is difficult to improve patients' visual function, and the MH closure rate is limited. Comparatively, the internal limiting membrane flap technique is suitable for patients with large-diameter macular holes, which can maximize hole closure and improve surgical effectiveness [2]. Therefore, this study selected 102 patients with HMMH (diameter ≤ 500μm) to evaluate the implementation effect of the internal limiting membrane flap technique.

## 2. Materials and methods

### 2.1. General information

One hundred and two patients with HMMH (diameter ≤ 500μm) admitted to the hospital from October 2019 to October 2024 are included and randomly divided into two groups. The experimental group consisted of 51 patients, including 31 males and 20 females, aged between 40–79 years old, with a mean age of (55.18 ± 4.16) years. The course of disease ranged from 3–15 months, with a mean duration of (9.15 ± 1.75) months. The axial length ranged from 26–31mm, with a mean of (28.97 ± 1.48)mm. The minimum diameter of MH ranged from 400–410μm, with a mean of (404.53 ± 14.26)μm. The control group consisted of 51 patients, including 29 males and 22 females, aged between 41–78 years old, with a mean age of (55.20 ± 4.24) years. The course of disease ranged from 4–14 months, with a mean duration of (9.09 ± 1.71) months. The axial length ranged from 27–33mm, with a mean of (28.88 ± 1.45)mm. The minimum diameter of MH ranged from 401–411μm, with a mean of (404.72 ± 14.48)μm. There was no statistically significant difference between the two groups ($P > 0.05$).

Inclusion criteria: Patients are confirmed as having high myopia through fundus examination, with an axial length between 26–33mm. A comprehensive diagnosis of MH was made based on optical coherence tomography (OCT) and fundus angiography. Patients were adults, had normal communication skills and consciousness, complete clinical data, and were highly informed about the study. Exclusion criteria: Patients with a history of ocular trauma or surgery, other ocular diseases, coagulation or immune system abnormalities, malignancies, organ dysfunction, or mental illnesses are excluded.

### 2.2. Methods

All patients underwent ophthalmic examinations such as best-corrected visual acuity, non-contact intraocular pressure, and OCT before surgery to ensure that they met the surgical indications. The same surgeon performed the operation, using a minimally invasive three-channel (25G) vitrectomy at the pars plana and precise excision with a wide-angle lens. Triamcinolone acetonide is selected as the staining agent, and indocyanine green is used to stain the internal limiting membrane at a concentration of 5g/L.

The experimental group is combined with the internal limiting membrane flap technique. The internal limiting membrane is torn along the MH using a circular tearing method, with a diameter of about two times the diameter of the optic disc. The vitrectomy probe is used to moderately preserve the internal limiting membrane at the edge of the MH, ensuring it is not disconnected. The residual tissue of the internal limiting membrane is flipped to cover the MH. Subsequently, gas-liquid exchange treatment is performed to smoothly discharge the fluid under the retina, and the internal limiting membrane flap was flipped into the macular hole to fill the area.

The control group is treated with internal limiting membrane peeling, completely peeling off the internal limiting membrane within the range of the vascular arch. Gas-liquid exchange is performed, and the incision is sutured with an 8-0 suture after confirming no leakage at the puncture site and the presence of bubbles under the conjunctiva. After surgery, patients in both groups are instructed to keep their faces downward for 3 days to promote MH closure.

## 2.3. Observation indicators

(1) Therapeutic effect indicators

(a) MH closure rate: OCT examination is performed. If the two sides of the fissure are tightly fitted and connected, it is considered as completely closed; if there are pores at the broken end of the fissure that are in contact with the retinal pigment epithelium, it is considered as an exposed closure; if the broken end of the fissure is raised and the retina is detached, it is considered as unclosed. The completely closed state is recorded as the closure rate.

(b) Retinal reposition: If the retinal pigment epithelium in the macular area is tightly fitted to the neuroepithelium, it is considered as successfully repositioned.

(2) Best corrected visual acuity level

Preoperatively and postoperatively at 1, 3, and 6 months, the best corrected visual acuity level is evaluated using the international standard logarithmic visual acuity chart and converted to the logarithm of the minimum angle of resolution (Log MAR) value.

(3) Complication rate

Observe the probabilities of intraocular infection, visual field defects, elevated intraocular pressure, and poor incision closure.

(4) Quality of life score

The Chinese version of the Vision-Related Quality of Life Questionnaire-25 (CVRQOL-25) is used, which contains 25 questions in 12 categories, all related to visual function, specifically including near activities, overall health, distance activities, social functioning, peripheral vision, mental health, dependence, and color vision. Each question is scored from 0 to 100, with intervals of 25 corresponding to grades A to E. The average score for each category is recorded, and the total score of the questionnaire is converted to a scale of 0 to 100, with higher scores indicating better quality of life.

## 2.4. Statistical analysis

Data processing is done using SPSS 28.0 software. Measurement values are compared and tested using t-values, while count values are compared and tested using chi-square values. The criterion for statistical significance is a $P$-value < 0.05.

# 3. Results

## 3.1. Comparison of therapeutic effect indicators between the two groups

At 3 and 6 months postoperatively, the MH closure rate and retinal reposition rate in the experimental group were higher than those in the reference group ($P < 0.05$). The results are shown in **Table 1** and **Table 2**.

**Table 1.** Comparison of therapeutic effect indicators between the two groups at 3 months postoperatively [n/%]

| Group | Number of cases | MH closure rate | | | Retinal reattachment rate |
|---|---|---|---|---|---|
| | | Complete closure | Exposed closure | Not closed | |
| Experimental group | 51 | 43(84.31) | 6(11.76) | 2(3.92) | 50(98.04) |
| Control group | 51 | 34(66.67) | 10(19.61) | 7(13.73) | 44(86.27) |
| $x^2$ | - | 4.292 | 1.186 | 3.047 | 4.883 |
| *P* | - | 0.038 | 0.276 | 0.081 | 0.027 |

**Table 2.** Comparison of therapeutic effect indicators between the two groups at 6 months postoperatively [n/%]

| Group | Number of cases | MH closure rate | | | Retinal reattachment rate |
|---|---|---|---|---|---|
| | | Complete closure | Exposed closure | Not closed | |
| Experimental group | 51 | 49(96.08) | 2(3.92) | 0 | 51(100.00) |
| Control group | 51 | 41(80.39) | 6(11.76) | 4(7.84) | 46(90.20) |
| $x^2$ | - | 6.044 | 2.170 | 4.163 | 5.258 |
| *P* | - | 0.014 | 0.141 | 0.041 | 0.022 |

## 3.2. Comparison of best corrected visual acuity between the two groups

There was no difference in the best corrected visual acuity between the two groups before surgery and at 1 month postoperatively ($P > 0.05$). However, at 3 and 6 months postoperatively, the best corrected visual acuity in the experimental group was higher than that in the reference group ($P < 0.05$). The results are shown in **Table 3**.

**Table 3.** Comparison of best corrected visual acuity between the two groups [$\bar{x}$±s, Log MAR]

| Group | Number of Cases | Pre-operation | 1 Month Post-operation | 3 Months Post-operation | 6 Months Post-operation |
|---|---|---|---|---|---|
| Experimental group | 51 | 0.14 ± 0.05 | 0.31 ± 0.12 | 0.40 ± 0.10 | 0.47 ± 0.11 |
| Control group | 51 | 0.12 ± 0.07 | 0.30 ± 0.14 | 0.35 ± 0.08 | 0.42 ± 0.08 |
| *t* | - | 1.660 | 0.387 | 2.788 | 2.625 |
| *P* | - | 0.100 | 0.699 | 0.006 | 0.010 |

## 3.3. Comparison of complication rates between the two groups

The complication rate in the experimental group was similar to that in the reference group ($P > 0.05$). The results are shown in **Table 4**.

**Table 4.** Comparison of complication rates between the two groups [n/%]

| Group | Number of cases | Intraocular infection | Visual field defect | Increased intraocular pressure | Poor incision closure | Incidence rate |
|---|---|---|---|---|---|---|
| Experimental group | 51 | 1(1.96) | 0 | 1(1.96) | 0 | 3.92(2/51) |
| Control group | 51 | 1(1.96) | 1(1.96) | 1(1.96) | 1(1.96) | 7.84(4/51) |
| $x^2$ | - | - | - | - | - | 0.708 |
| *P* | - | - | - | - | - | 0.400 |

### 3.4. Comparison of quality of life scores between the two groups

Before surgery and at 1 month postoperatively, the quality of life scores in the experimental group were similar to those in the reference group ($P < 0.05$). However, at 3 and 6 months postoperatively, the quality of life scores in the experimental group were higher than those in the reference group ($P < 0.05$), as shown in **Table 5**.

**Table 5.** Comparison of quality of life scores between the two groups [$\bar{x}$±s, points]

| Group | Number of cases | Pre-operation | 1 Month post-operation | 3 Months post-operation | 6 Months post-operation |
|---|---|---|---|---|---|
| Experimental Group | | 50.17 ± 3.53 | 59.19 ± 3.14 | 68.14 ± 3.41 | 72.65 ± 4.18 |
| Control Group | 51 | 50.22 ± 3.49 | 55.09 ± 3.21 | 64.02 ± 3.17 | 66.48 ± 4.32 |
| *t* | - | 0.072 | 6.521 | 6.319 | 7.330 |
| *P* | - | 0.943 | < 0.001 | < 0.001 | < 0.001 |

## 4. Discussion

High myopia is a risk factor for macular hole (MH), and the two often coexist [3, 4]. The pathogenic factors of high myopia macular hole (HMMH) include persistent traction on the macular area by the epiretinal membrane or posterior cortical vitreous, as well as vitreous degeneration and posterior scleral staphyloma. After the appearance of a hole in the macular area, surrounding glia continuously release cytokines, exacerbating inflammatory reactions, which leads to the generation of a large amount of collagen fibers. This can further increase traction forces, causing the hole to gradually expand. Common surgical procedures for this disease include posterior scleral buckling or pars plana vitrectomy (PPV), which can quickly reposition the retina and improve symptoms such as metamorphopsia. However, these procedures have limited effectiveness in healing MH and improving visual function, resulting in general long-term treatment effects and a high risk of recurrence [5].

Internal limiting membrane (ILM) peeling is a commonly used adjunctive procedure in PPV. It involves the removal of a large area of the ILM, which can rapidly relieve the traction forces exerted by the ILM, thereby improving the MH closure rate. Additionally, peeling treatment can prevent hole recurrence, stabilize surgical efficacy, and prevent adverse events such as vision loss due to hole reopening [6]. However, this surgical procedure carries a high risk and can easily lead to complications such as intraocular infection. More importantly, ILM peeling can alter the retinal structure, potentially affecting its function. This can result in significant thinning of the retinal nerve fiber layer, which may induce retinal pathology and negatively impact disease prognosis. ILM flap technique can repair glial cells and act as a scaffold for proliferative tissue in MH. This improves photoreceptor cell function, allowing these cells to accumulate in the center of the hole, thereby filling the hole, extending the length of the retina, and ultimately repairing the hole. As a result, the macular morphology of HMMH patients can be significantly improved, and their best-corrected visual acuity (BCVA) can be enhanced [7, 8].

The results showed that the MH closure rate and retinal reposition rate at 3 and 6 months postoperatively were higher in the experimental group than in the reference group ($P < 0.05$). At 3 and 6 months postoperatively, the BCVA and quality of life scores were also higher in the experimental group than in the reference group ($P < 0.05$). The reason for this may be that after ILM flap technique treatment, gas absorption may cause slight drift of the flap, leading to closure failure in a few patients. Overall, however, the ILM flap technique is highly feasible. The use of a circular peeling technique during surgery allows for appropriate removal of the ILM, thereby eliminating various factors that pull on the macular area. This can relax the retina, restore RT levels, and promote effective hole closure [9]. Additionally, the flap technique adequately preserves the hole edges and flips the ILM to the MH site, functioning as a biological scaffold. This promotes effective proliferation of neuroepithelial cells, enabling the retina to grow towards the center of the hole, closing the hole and repositioning the retina [10].

The complication rate in the experimental group was similar to that in the reference group ($P > 0.05$). This may be due to the mature surgical techniques used in the combined procedures, which can provide nutritional support to the whole area while relieving traction. These procedures also enhance the adhesion between cells and the extracellular matrix, ensuring that the ILM closely adheres to the retina and preventing conditions such as visual field defects [11]. Furthermore, the use of a minimally invasive three-channel approach for vitrectomy in these procedures allows for smaller incisions, reducing the risk of bleeding and infection. Coupled with reasonable handling of the ILM to prevent excessive peeling, these techniques minimize retinal damage and postoperative complications [12].

## 5. Conclusion

In conclusion, the ILM flap technique can enhance the clinical efficacy of HMMH patients (with a diameter ≤500μm). It not only restores vision but also reduces complications and significantly improves patients' quality of life. The surgical feasibility of this technique is high.

## Disclosure statement

The author declares no conflict of interest.

## References

[1] Hao Z, 2020, Clinical Efficacy of Vitrectomy Combined with Internal Limiting Membrane Peeling in the Treatment of Macular Hole in High Myopia. Journal of Practical Medicine, 37(2): 114–116.

[2] Fu Z, Wang R, Xu Y, et al., 2022, Observation on the Curative Effect of Vitrectomy Combined with Internal Limiting Membrane Peeling in the Treatment of Macular Hole in High Myopia. Practical Blindness Prevention Technology, 17(1): 17–19.

[3] Li N, Xiao L, 2020, Analysis of the Efficacy of Vitrectomy with Internal Limiting Membrane Peeling in the Treatment of Retinal Detachment Caused by Macular Hole in High Myopia. Capital Food and Medicine, 27(21): 17–18.

[4] Li W, Wang R, Tang W, 2025, Effect of Vitrectomy Combined with Internal Limiting Membrane Inversion and Tamponade in the Treatment of Retinal Detachment Caused by Macular Hole in Patients with High Myopia. Kangmin Medical Journal of China, 37(4): 47–50.

[5] Zhu W, Li W, Xu P, 2023, PPV Combined with Internal Limiting Membrane Inversion and Tamponade in the Treatment of Retinal Detachment Caused by Macular Hole in High Myopia. International Journal of Ophthalmology, 23(4): 640–643.

[6] Wang C, Zhou J, Yao T, et al., 2024, Comparison of the Efficacy of Human Amniotic Membrane Tamponade and Internal Limiting Membrane Inversion Tamponade in the Treatment of Retinal Detachment Caused by Macular Hole in High Myopia. Chinese Journal of Experimental Ophthalmology, 42(1): 47–52.

[7] Pan Y, Yang J, Yi B, et al., 2023, Comparative Observation on the Efficacy of Internal Limiting Membrane Inversion

Coverage and Multilayer Tamponade in the Treatment of Retinal Detachment Caused by Macular Hole in High Myopia. Chinese Journal of Fundus Diseases, 39(12): 964–968.

[8] Sun Y, 2023, Application of Internal Limiting Membrane Inversion Tamponade and Internal Limiting Membrane Peeling in Retinal Detachment Caused by Macular Hole in High Myopia. Journal of Shandong Medical College, 45(1): 9–12.

[9] Guo J, Gao Y, 2022, Evaluation of the Efficacy of Internal Limiting Membrane Peeling and Inversion Tamponade in the Adjuvant Treatment of Patients with Retinal Detachment Caused by Macular Hole in High Myopia. Practical Blindness Prevention Technology, 17(1): 7–9.

[10] Li Q, Hong M, Xie Y, et al., 2023, Clinical Comparative Study of Vitrectomy Combined with Internal Limiting Membrane Peeling and Vitrectomy in the Treatment of Retinal Detachment Caused by Macular Hole in High Myopia. Henan Journal of Surgery, 29(3): 164–166.

[11] Liu J, Zheng Y, Yang X, 2024, Comparison of the Effects of Vitrectomy Combined with Internal Limiting Membrane Peeling and Internal Limiting Membrane Coverage in the Treatment of Retinal Detachment Caused by Macular Hole in High Myopia. Clinical Medicine, 44(12): 29–31.

[12] Hou Y, Liu L, Wang G, et al., 2020, Comparison of the Efficacy of Vitrectomy Combined with Internal Limiting Membrane Coverage and Peeling Surgery in the Treatment of Retinal Detachment Caused by Macular Hole in High Myopia. Chinese Journal of Fundus Diseases, 36(12): 943–947.

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