

Success of Pars Plana Vitrectomy (PPV) With Internal Limiting Membrane (ILM) Peel for Management of Macular Hole

Dr Muhammad Amin¹, Dr Chakar Tajwidi², Dr Abdul Bari³, Dr Muhammad Tahir Ghaffar⁴,
Dr Mohammad Hasan Bokhari⁵, Dr Muhammad Abid Javed⁶

¹Assistant Professor, Loralai Medical College

²Assistant Professor, Mekran Medical College, Health Department, Balochistan

³Assistant Professor, Sheikh Zayed Hospital, Quetta

⁴Assistant Professor, Al Aleem Medical College, Lahore

⁵Senior Registrar, Mayo Hospital Lahore / KEMU, Lahore

⁶Senior Registrar, Eye unit 3, Mayo Hospital, Lahore

ABSTRACT

BACKGROUND: Peeling the internal limiting membrane of the retina has become a very common procedure performed by vitreo retinal surgeons. The combination of new microsurgical instrumentation with the availability of different dyes to stain this thin and transparent membrane has facilitated the performance of internal limiting membrane peeling, reducing the time and trauma associated with this maneuver. It appears that peeling the internal limiting membrane in these retinal conditions may be associated with better anatomical and visual outcomes following surgery.

OBJECTIVE: To determine the frequency of success of pars plana vitrectomy (PPV) with internal limiting membrane (ILM) peel for management of macular hole.

METHODS: This was a descriptive case series. Study was conducted at Eye unit III, Institute of Ophthalmology, KEMU/ Mayo Hospital, Lahore. Total 115 patients were included in this study. Patients selection was done by using pre defined inclusion and exclusion criteria. Data entry and analysis was done by using SPSS 17.

RESULTS: Mean age of all patients was 61.71 ± 5.81 years. Whereas mean age of male and female patients was 61.90 ± 6.10 and 61.49 ± 5.5 years respectively. Macular hole stage of patients showed that 72(63%) patients had stage-II and 43(37%) patients had stage-III. Postoperative serial OCT's was done to measure the size of macular hole

at first post operative day, 1st week, 1st month and finally on 2nd post-operative month. Mean OCT pre operatively was 362.93 ± 85.77 (μm), at 1st day 169.61 ± 57.74 (μm), at 1st week post operatively 120.17 ± 49.53 (μm), at 1st month 74.22 ± 61.97 (μm) and at 2nd month post operatively mean OCT was 30.00 ± 6.53 (μm). Success of pars plana vitrectomy (PPV) with internal limiting membrane (ILM) peel was achieved in 96 (83%) patients while there were 19 (17%) patients among them failure was observed.

CONCLUSION: Pars plana vitrectomy with internal limiting membrane peel for management of macular hole is effective method of treatment. It provides good results for anatomical and functional outcome.

KEY WORDS: Macular Hole, OCT, Pars Plana vitrectomy (PPV), Internal limiting membrane (ILM).

INTRODUCTION

Macular Hole is a common cause of central visual loss in patients above 55 years of age, usually in females. Although the exact incidence and prevalence of macular hole is not ascertained in our population, still it comprises a significant proportion of patients presenting in eye outdoor.(1)

The macula is a round area at the posterior pole, lying inside the temporal vascular arcades. It measures between 5 and 6 mm in diameter, and subserves the central 15–20° of the visual field. Histologically, it shows more than one layer of ganglion cells, in contrast to the single ganglion cell layer of the peripheral retina. It contains the fovea, the foveola and the umbo.(2)

Anteroposterior and tangential vitreous traction on the fovea, as the primary underlying cause, and retinal hydration play a major role in MH formation. About 80 % of cases of macular hole are idiopathic, while 10% because of trauma. MH have also been associated with cystic macular edema, inflammation, degenerative conditions of the retina, epiretinal macular membranes and solar retinopathy.(3)

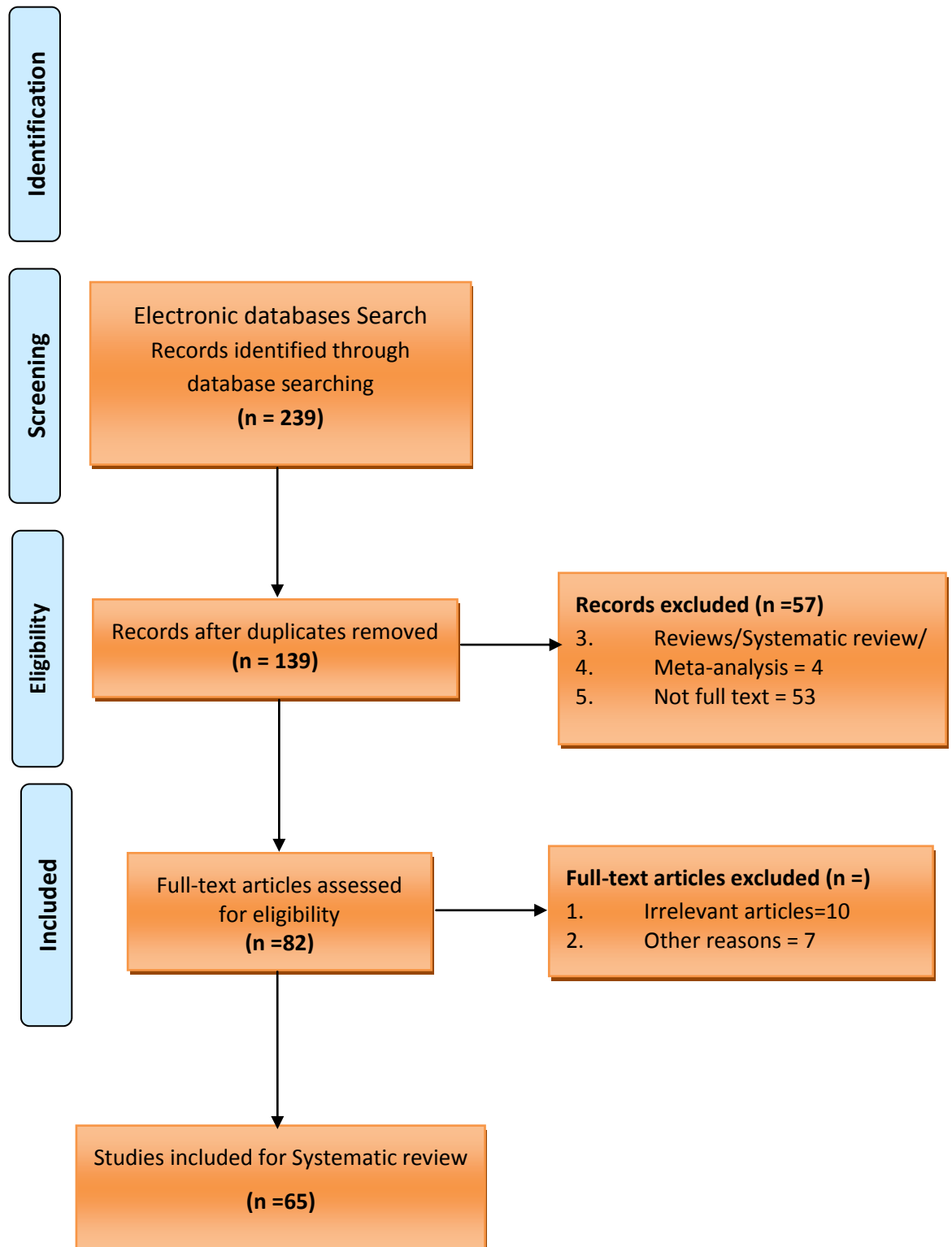
Improved understanding of the natural history and patho-physiology of MH has led to recent advances in the surgical management of patients with this hitherto un-treatable disease. Pars plana vitrectomy with peeling of the internal limiting membrane (ILM) is a widely used surgical technique for MH surgery. Postoperative success may be attributable to complete removal of the posterior vitreous cortex with the ILM and subsequent release of tangential traction.(4, 5)

Optical coherence tomography(OCT) is routinely used to detect macular abnormalities. It is analogous to ultrasound imaging, except that OCT performs imaging by measuring the echo time delay and magnitude of back reflected light.(5)

Ko et al., reported that with the addition of ILM peeling to the surgical procedure, recent anatomical closure rates of 85% to 100% have been reported. One study, in 2011, reported that anatomical closure was observed in 92% cases on OCT 2 months after the procedure of ILM.(6, 7)

The purpose of my study is to determine the success of pars plana vitrectomy (PPV) for management of macular hole(MH). If MH remains untreated, it may lead to severe loss of vision to 6/60 and even worse. PPV is the only treatment option for MH. With advancement of science and medicine, ILM is newly introduced technique which improves the success of PPV. Results are same whether we follow the patients for 2 months or 6 months. We want to conduct this study to see whether PPV in addition to ILM peel may improve its success rate or not and see the outcome of the procedure on OCT. Through this study we also want to confirm the success rate.

LITEARTURE REVIEW PRISMA FLOW DIAGRAM:



METHODOLOGY:

SAMPLE SIZE

Sample size of 115 cases is calculated with 95% confidence level, 5% margin of error and taking expected percentage of success of PPV i.e. 92% with ILM for management of macular hole.

SAMPLE TECHNIQUE

Non-probability purposive sampling technique was used.

INCLUSION CRITERIA

- Patients of age 50-80 years
- Both gender with idiopathic Stage II and stage III macular hole (as per operational definition).

EXCLUSION CRITERIA

Pseudomacular hole, Macular cyst and Secondary macular hole (assessed on clinical examination and OCT).

DATA COLLECTION PROCEDURE

Total 115 cases fulfilling inclusion criteria were registered through OPD, and demographic information (name, age, sex and address) were obtained. Preoperative OCT was performed to measure the size of macular hole. PPV with ILM (persistent fibrillar condensation of the vitreous body of the eye forming the innermost layer of the retina) with gas tamponade was done in all cases by a single surgeon.

Postoperative serial OCT's were done to measure the size of macular hole at first postoperative day, 1st week, 1st month and finally on 2nd post-operative month and success was labeled (as per operational definition)s. All the information was collected by a proforma.

DATA ANALYSIS

The collected information was entered in SPSS version 17.00. Mean and standard deviation of quantities like age was calculated. Frequency and percentage was calculated for qualitative variables like gender and anatomical closure after 2 months of the procedure. Data was stratified for size of macular hole (<400µm, >400µm) to address effect modifiers.

RESULTS:

Mean age of all patients was 61.71 ± 5.81 years. Whereas mean age of male and female patients was 61.90 ± 6.10 and 61.49 ± 5.5 years respectively. Minimum and maximum age of male patients was 50 and 74 years respectively. Whereas minimum and maximum age of female patients was 51 and 73 years respectively. (**Table-1**)

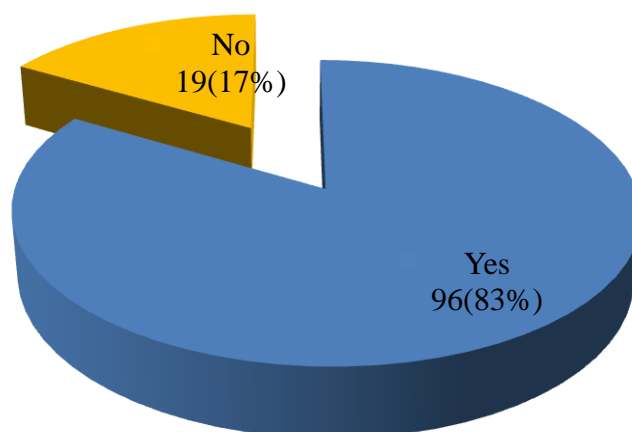
	<i>Gender</i>		Total
	<i>Male</i>	<i>Female</i>	
<i>N</i>	62	53	115
<i>Mean</i>	61.90	61.49	61.71
<i>Std. Deviation</i>	6.10	5.50	5.81
<i>Minimum</i>	50	51	50
<i>Maximum</i>	74	73	74

Postoperative serial OCT's was done to measure the size of macular hole at first post operative day, 1st week, 1st month and finally on 2nd post-operative month. Mean OCT pre operatively was 362.93 ± 85.77 (μm), at 1st day 169.61 ± 57.74 (μm), at 1st week post operatively 120.17 ± 49.53 (μm), at 1st month 74.22 ± 61.97 (μm) and at 2nd month post operatively mean OCT was 30.00 ± 6.53 (μm) (**Table-2**)

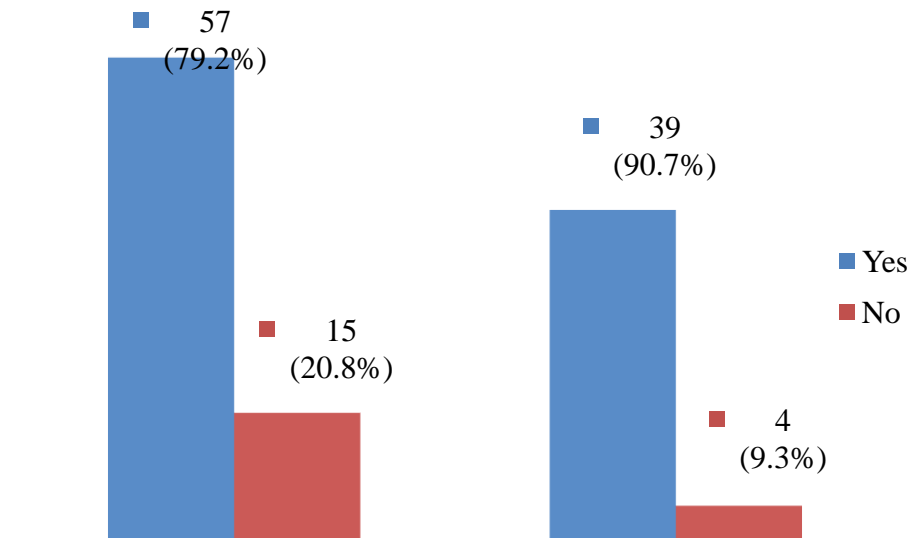
	<i>OCT(μm)</i>				
	<i>Pre-Op</i>	<i>1st Day</i>	<i>1st Week</i>	<i>1st Month</i>	<i>2nd Month</i>
<i>N</i>	115	115	115	115	115
<i>Mean</i>	362.93	169.61	120.17	74.22	30.00

<i>Std. Deviation</i>	85.77	57.74	49.53	61.97	6.53
<i>Minimum</i>	249	106	68	30	0
<i>Maximum</i>	600	300	250	250	250

Success of pars plana vitrectomy (PPV) with internal limiting membrane (ILM) peel was achieved in 96 (83%) patients while there were 19(17%) patients among them failures was observed. **(Figure-1)**



Success of Pars Plana Vitrectomy with internal limiting membrane peel was stratified in relation to macular hole size $<400\ \mu\text{m}$ and $>400\ \mu\text{m}$ to address the effect modifier. Patients whose macular hole size was $<400\ \mu\text{m}$ among them success was achieved in 57(79.2%) patients and those patients whose macular hole size was $>400\ \mu\text{m}$ among them success of PPV was achieved in 39(90.7%) patients respectively. **(Figure-2)**



DISCUSSION:

Macular hole is an important cause of central visual loss and the overall prevalence is approximately 3.3 per 1000. Macular hole can be associated with trauma or myopia but most common cause is idiopathic. Idiopathic macular hole are commonly seen in women in the seventh decade of life without any apparent predisposing conditions. Kelly and Wendel introduced a surgical procedure to close macular holes. They achieved an anatomical closure rate of 73% and visual improvement of two or more lines. During the last decade closure rates have improved significantly due to improved surgical techniques. Brooks has shown significant improvement in anatomical and functional outcome after Macular Hole surgery.(8-13)

The rationale for the surgical management of idiopathic macular holes, originally described by Kelly and Wendel in 1991, is to relieve vitreo foveal traction and to flatten and re appose the macular hole edges by intraocular tamponade. This is achieved by three-port pars plana vitrectomy with meticulous removal of posterior cortical vitreous and of any epiretinal membranes at the macula. A peripheral vitrectomy is completed and the retinal periphery inspected for iatrogenic retinal breaks. An air fluid exchange is performed and the intraocular air is usually exchanged for long-acting gas or silicone oil tamponade. Modifications of the original technique include peeling of the inner limiting membrane with or without local application of an adjuvant in an effort to promote healing by glial repair. Patients may be advised to posture in a face down position for up to 14 days postoperatively.(14)

ILM peeling may help, also, by ensuring complete removal of any epiretinal tissues above the ILM that could cause foveal traction as well as by stimulating gliosis.(15,

16) Some investigators have suggested that ILM peeling may allow shortening of the postoperative face-down period (or avoiding it altogether), usually recommended to patients by most vitreoretinal surgeons following FTMH surgery, (17, 18) as well as the use of air instead of a long-acting gas as internal tamponade agent, with still high anatomical success rates. (19-21)

Based on case control studies and large and small case series reported in the literature, good anatomical and functional results have been achieved using ILM peeling in idiopathic FTMH surgery, even possibly better than those observed following non ILM peeling.(22-30)

One recent status from Mayo Hospital Lahore evaluate the anatomic and visual outcome in patients undergoing pars plana vitrectomy (PPV) with internal limiting membrane (ILM) peel for idiopathic macular hole reported anatomical success rate for 86.7%.(31)

Gupta B and colleagues had the anatomical success rate of 86% and variable visual success rate. Brooks has shown significant improvement in anatomical and functional outcome after Macular Hole surgery. Brooks reported 100% closure in holes of less than 6 months duration with ILM peeling.(32,33)

Four stages of FTMH have been described.⁵ Randomized controlled clinical trials (RCTs) conducted in the 1990s showed that macular hole surgery was effective for stages 2, 3, and 4. Peeling the internal limiting membrane (ILM) of the retina was introduced as an additional maneuver in macular hole surgery to improve anatomic and functional outcomes after surgery. Several observational studies suggested a benefit of peeling the ILM (reviewed by Abdelkader and Lois). Furthermore, recent data from two small RCTs undertaken in China and Denmark, which included 49 and 75 patients, respectively, suggested a potential beneficial effect of this operation. (31-34)

In this study 37% patients macular hole stage was III and 63% of the patients presented with stage-IV. Pre operatively OCT findings shows a macular hole size of 362.93 ± 85.77 microns. AT 2nd month post operatively mean macular hole size was 30.00 ± 6.53 microns. This difference is mean macular hole size showing effectiveness of the macula hole surgery with pars plana vitrectomy (PPV) with internal limiting membrane (ILM) peel. Success of surgery in this study was 83% while in 17% success after this surgery was not achieved. This success rate lies in between the range reported by various studies done on this topic and success rate was comparable with other studies.

In 2000, Mester and Kuhn performed a meta analysis on 1,654 eyes from published reports dating from 1992 to 1999 on idiopathic FTMH surgery. They found that ILM peeling significantly improved the anatomical closure from 77% to 96% and the functional success (2 or more Snellen lines) from 55% to 81%.(34)

In 2006, Tognetto et al conducted a retrospective multicentre evaluation of 1,627 nonconsecutive idiopathic FTMH operated on between 1993 to 2003 with ILM peeling (n = 1,100), with and without ICG staining, and without ILM peeling (n=5527). The authors found that ILM peeling statistically significantly improved the overall anatomical closure rate from 89% to 94.1%. The authors did not find a statistically significant difference in anatomical closure for stage two cases between the two groups but the difference was statistically significant for stage 3 and 4.(35)

Peeling the internal limiting membrane of the retina has become a very common procedure performed by vitreo retinal surgeons. The combination of new microsurgical instrumentation with the availability of different dyes to stain this thin and transparent membrane has facilitated the performance of internal limiting membrane peeling, reducing the time and trauma associated with this maneuver. Internal limiting membrane peeling has been used to treat a variety of retinal pathologies, including full thickness macular hole, epiretinal membrane, macular edema, vitreomacular traction syndrome, and Terson syndrome, among others. Although it appears that peeling the internal limiting membrane in these retinal conditions may be associated with better anatomical and visual outcomes following surgery, further evidence through randomized controlled clinical trials is still needed to guide the vitreo-retinal surgeon on the appropriate use of this surgical maneuver.

CONCLUSION:

Pars plana vitrectomy with internal limiting membrane peel for management of macular hole is effective method of treatment. It provides good results for anatomical and functional outcome.

REFERENCES:

1. Sen P, Bhargava A, Vijaya L, George R. Prevalence of idiopathic macular hole in adult rural and urban south Indian population. *Clinical & experimental ophthalmology*. 2008;36(3):257-60.
2. Kanski JJ, Bowling B. *Clinical Ophthalmology: A Systematic Approach E-Book: A Systematic Approach E-Book*: Saunders; 2011.
3. Bainbridge J, Herbert E, Gregor Z. Macular holes: vitreoretinal relationships and surgical approaches. *Eye*. 2008;22(10):1301-9.

4. Michalewska Z, Michalewski J, Sikorski BL, Kałużny JJ, Wojtkowski M, Adelman RA, et al. A study of macular hole formation by serial spectral optical coherence tomography. *Clinical & experimental ophthalmology*. 2009;37(4):373-83.
5. Targino A, Costa RA, Calucci D, Cardillo JA, Jorge R, Scott IU. OCT findings in macular hole formation in eyes with complete vitreofoveal separation. *Ophthalmic surgery, lasers & imaging: the official journal of the International Society for Imaging in the Eye*. 2008;39(1):65.
6. Ko TH, Witkin AJ, Fujimoto JG, Chan A, Rogers AH, Bauman CR, et al. Ultrahigh-resolution optical coherence tomography of surgically closed macular holes. *Archives of ophthalmology*. 2006;124(6):827.
7. Sanisoglu H, Sevim MS, Aktas B, Sevim S, Nohutcu A. Outcomes of 23-gauge pars plana vitrectomy and internal limiting membrane peeling with brilliant blue in macular hole. *Clinical Ophthalmology (Auckland, NZ)*. 2011;5:1177.
8. S. F. Discussion, macular holes. *Ophthalmology*. 1993;100: 871.
9. Margheria R, Schepens C. Macular breaks. 1. Diagnosis, etiology, and observations. *American journal of ophthalmology*. 1972;74(2):219-32.
10. Wendel R, Patel A, Kelly N, Salzano T, Wells J, Novack G. Vitreous surgery for macular holes. *Ophthalmology*. 1993;100(11):1671.
11. Scott RA, Ezra E, West JF, Gregor Z. Visual and anatomical results of surgery for long standing macular holes. *British journal of ophthalmology*. 2000;84(2):150-3.
12. Brooks Jr HL. Macular hole surgery with and without internal limiting membrane peeling. *Ophthalmology*. 2000;107(10):1939.
13. Kelly NE, Wendel RT. Vitreous surgery for idiopathic macular holes. Results of a pilot study. *Archives of ophthalmology*. 1991;109(5):654.
14. Yooh H, Brooks Jr H, Capone Jr A, L'Hernault NL, Grossniklaus HE. Ultrastructural features of tissue removed during idiopathic macular hole surgery. *American journal of ophthalmology*. 1996;122(1):67.
15. Nakamura T, Murata T, Hisatomi T, Enaida H, Sassa Y, Ueno A, et al. Ultrastructure of the vitreoretinal interface following the removal of the internal limiting membrane using indocyanine green. *Current eye research*. 2003;27(6):395-9.
16. Lai M, Tang S, Li J, Liu X, Ling Y, Zheng X. Observation of early closure of idiopathic macular hole after vitrectomy surgery with internal limiting membrane peeling]. *Yan ke xue bao= Eye science/" Yan ke xue bao" bian ji bu*. 2004;20(2):93.
17. Kwok A, Lai T, Wong V. Idiopathic macular hole surgery in Chinese patients: a randomised study to compare indocyanine green-assisted internal limiting membrane peeling with no internal limiting membrane peeling. *Hong Kong medical journal= Xianggang yi xue za zhi/Hong Kong Academy of Medicine*. 2005;11(4):259.

18. Park DW, Sipperley JO, Sneed SR, Dugel PU, Jacobsen J, SMIDDY W. Macular hole surgery with internal-limiting membrane peeling and intravitreal air. Discussion. *Ophthalmology*. 1999;106(7):1392-8.
19. Sato Y, Isomae T. Macular hole surgery with internal limiting membrane removal, air tamponade, and 1-day prone positioning. *Japanese journal of ophthalmology*. 2003;47(5):503-6.
20. WICKENS JC, SHAH GK. Outcomes of macular hole surgery and shortened face down positioning. *Retina*. 2006;26(8):902-4.
21. Al-Abdulla NA, Thompson JT, Sjaarda RN. Results of macular hole surgery with and without epiretinal dissection or internal limiting membrane removal. *Ophthalmology*. 2004;111(1):142-9.
22. Castro NJ, Gonzalez-Castano C. Macular hole surgery with and without internal limiting membrane peeling]. *Archivos de la Sociedad Española de Oftalmología*. 2003;78(3):159.
23. Foulquier S, Glacet-Bernard A, Sterkers M, Soubrane G, Coscas G. [Study of internal limiting membrane peeling in stage-3 and-4 idiopathic macular hole surgery]. *Journal francais d'ophtalmologie*. 2002;25(10):1026.
24. Kube T, Hermel M, Dahlke C, Hutschenreuter G, Schrage N, Kirchhof B. Macular hole surgery: experience with autologous platelet concentrate and indocyanine green-assisted internal limiting membrane peeling]. *Klinische Monatsblätter für Augenheilkunde*. 2002;219(12):883.
25. Kumagai K, Ogino N, editors. Results of macular hole surgery combined with PEA and IOL. *Seminars in ophthalmology*; 2001: Informa UK Ltd UK.
26. Kwok AK, Lai TY, Yuen KS, Tam BS, Wong VW. Macular hole surgery with or without indocyanine green stained internal limiting membrane peeling. *Clinical & experimental ophthalmology*. 2003;31(6):470-5.
27. Sheidow TG, Blinder KJ, Holekamp N, Joseph D, Shah G, Grand MG, et al. Outcome results in macular hole surgery: an evaluation of internal limiting membrane peeling with and without indocyanine green. *Ophthalmology*. 2003;110(9):1697.
28. Tadayoni R, Gaudric A, Haouchine B, Massin P. Relationship between macular hole size and the potential benefit of internal limiting membrane peeling. *British journal of ophthalmology*. 2006;90(10):1239-41.
29. Ahmad N, Shah SRA, Ch QL, Tahir MY, Mahju TM, Ahmed CN, et al. Outcome of Macular Hole Surgery at Mayo Hospital, Lahore. *Pakistan Journal of Ophthalmology*. 2012;28(2):77.

30. Gupta B, Laidlaw D, Williamson T, Shah S, Wong R, Wren S. Predicting visual success in macular hole surgery. *British journal of ophthalmology*. 2009;93(11):1488-91.
31. Kim JW, Freeman WR, Azen SP, El-Haig W, Klein DJ, Bailey IL. Prospective randomized trial of vitrectomy or observation for stage 2 macular holes. Vitrectomy for Macular Hole Study Group. *American journal of ophthalmology*. 1996;121(6):605.
32. Abdelkader E, Lois N. Internal limiting membrane peeling in vitreo-retinal surgery. *Survey of ophthalmology*. 2008;53(4):368-96.
33. Christensen UC, Krøyer K, Sander B, Larsen M, Henning V, Villumsen J, et al. Value of internal limiting membrane peeling in surgery for idiopathic macular hole stage 2 and 3: a randomised clinical trial. *British journal of ophthalmology*. 2009;93(8):1005-15.
34. Mester V, Kuhn F. Internal limiting membrane removal in the management of full-thickness macular holes. *American journal of ophthalmology*. 2000;129(6):769-77.
35. Tognetto D, Grandin R, Sanguinetti G, Minutola D, Di Nicola M, Di Mascio R, et al. Internal limiting membrane removal during macular hole surgery: results of a multicenter retrospective study. *Ophthalmology*. 2006;113(8):1401-10.