

Research Article

Effects of internal limiting Membrane Peeling versus no internal limiting Membrane Peeling on anatomical and visual outcomes in diabetic tractional detachment

Dr Sana Naveed, Dr Summaya Anjum, Dr Tahira Afzal Khan*, Dr Aziz Jan Bashir, Dr Mahwish Shahid, Dr Salman Sohail

¹Senior Registrar Vitreoretinal department Alshifa Trust Eye Hospital, Rawalpindi, naveed_sana@ymail.com

²Assistant Professor Pediatrics Ophthalmology Alshifa Trust Eye Hospital, Rawalpindi, summaya.anjum@gmail.com

³Assistant Professor, Vitreoretinal department Alshifa Trust Eye Hospital, Rawalpindi, tahiraakhan@hotmail.com

⁴Professor Vitreoretinal department Alshifa Trust Eye Hospital, Rawalpindi, azizjan_bashir@hotmail.com

⁵Registrar Vitreoretinal department Alshifa Trust Eye Hospital, Rawalpindi, msmalik603@gmail.com

⁶Registrar Vitreoretinal department Alshifa Trust Eye Hospital, Rawalpindi, ssc_sohail@hotmail.com

Corresponding Author: Dr Tahira Afzal Khan, Assistant Professor, Vitreoretinal department Alshifa Trust Eye Hospital, Rawalpindi, tahiraakhan@hotmail.com

ABSTRACT

Background: Diabetic tractional retinal detachment (TRD) is a vision-threatening complication of proliferative diabetic retinopathy. **Objective:** To evaluate the effects of ILM peeling versus no ILM peeling on anatomical and functional outcomes in patients undergoing vitrectomy for diabetic TRD. **Methods:** This prospective randomized controlled trial was conducted at Alshifa Trust Eye Hospital, Rawalpindi from 1st July 2024 to 31st December 2024. A total of 316 patients with TRD were randomized into two groups: Group A (vitrectomy with ILM peeling, n = 158) and Group B (vitrectomy without ILM peeling, n = 158). Baseline demographics, best-corrected visual acuity (BCVA), and OCT parameters were comparable between groups. **Results:** At 6 months, the reattachment rate was higher in Group A (95.6%) compared to Group B (89.2%,

p = 0.04). Group A demonstrated significantly lower mean CMT ($291 \pm 42 \mu\text{m}$ vs. $326 \pm 58 \mu\text{m}$, $p < 0.001$) and reduced total macular volume ($8.4 \pm 0.7 \text{ mm}^3$ vs. $8.9 \pm 0.9 \text{ mm}^3$, $p = 0.002$). Postoperative ERM formation was less frequent in the peeling group (6.3% vs. 18.4%, $p = 0.001$). Mean BCVA improved more in Group A (from 1.32 ± 0.28 to $0.74 \pm 0.22 \text{ logMAR}$) compared with Group B (from 1.29 ± 0.31 to $0.88 \pm 0.27 \text{ logMAR}$, $p = 0.003$). Contrast sensitivity was also significantly better in Group A ($p = 0.01$). Intra- and postoperative complication rates, including retinal breaks, hemorrhage, and recurrent detachment, were comparable between groups. **Conclusion:** ILM peeling during vitrectomy for diabetic TRD resulted in superior anatomical and visual outcomes without increasing surgical risks. The procedure reduced postoperative ERM formation, enhanced retinal remodeling, and improved BCVA and contrast

sensitivity.

Keywords: Diabetic tractional retinal detachment, vitrectomy, internal limiting membrane peeling, visual outcomes, macular thickness

INTRODUCTION

Diabetic tractional retinal detachment (TRD) represents one of the most challenging sequelae of proliferative diabetic retinopathy (PDR), a condition already recognized as a leading cause of irreversible visual impairment in working-age adults worldwide. PDR occurs in reaction to long-term retinal ischemia, which causes the expression of proangiogenic vascular endothelial growth factor (the development of delicate neovascular membranes) [1]. These fibrovascular complexes are strongly stuck to the posterior hyaloid and generate the force of contraction, as a result of which the retina is raised and the macula detached. Surgical treatment, most typically pars plana vitrectomy (PPV) is the treatment of choice when it comes to TRD [2]. The most important aim is to eliminate tractional components and restore retinal detachment; however, functional performance often follows anatomical recovery, with most patients making only limited gains in vision [3].

In the setting of vitrectomy to treat diabetic TRD, there has been the infiltration of internal limiting membrane (ILM) peeling, as an addition to the standard methods of surgery. The ILM, the innermost layer of the retina, consists of the basal lamina of the Muller cells and structures it as a scaffold on which to create glia cells proliferate and form ERM. It is postulated that the removal of the ILM during vitrectomy decreases the substrate available to form postoperative ERM and consequently maintains macular structure, protecting perhaps functional recovery [4]. Elimination of tangential tractional forces that

exist even when fibrovascular tissue has been withdrawn by ILM peeling may also facilitate recovery of a more normal foveal profile and reduced CMT [5]. Nonetheless, there is controversy over ILM peeling in the diabetic eye. As opposed to idiopathic ERM or macular hole surgical repair, where ILM peeling has become the common standard, the diabetic retina is in a unique state of compromise [6]. Chronic ischemia, macular edema, and gliosis make the tissue brittle and extremely susceptible to any surgical trauma. Possible complications of ILM peeling are retinal hemorrhage, iatrogenic retinal breaks, paracentral scotomas, appearance of the inner retinal dimple on the surface of the optic disc, and a diffused appearance of the optic nerve fiber layer. Also, the possible complications of introducing vital dyes like indocyanine green (ICG) or brilliant blue G in order to aid in visualization are an added variable, and in the case of indocyanine green (ICG), has even been linked to retinal toxicity. The dichotomy over the necessity of ILM peeling in diabetic TRD surgery continues, with these risks potentially influencing current opinion [7].

It will be shown that current evidence is mixed in literature. In some studies, it has been found that; peeling ILM is correlated with lower postoperative ERMs, better CMT outcomes using OCT and marginal improves in BCVA [8]. It has been reported that the visual outcomes depend largely on preoperative aspects of macular ischemia, integrity of final ellipsoid zone, duration of macular detachment, and the overall metabolic control and not on whether there was any ILM peeling or not [9]. Furthermore, surgery is not standardized: some surgeons recommend broad-field ILM peeling throughout the posterior pole, whereas other surgeons would use limited or fovea-sparing maneuvers to restrict the risk. Such heterogeneity

makes it hard to draw any conclusions [10]. To look through the lens of clinical decision-making, the orientation of weighing benefits against procedural risks is concerned. In a patient with extensive macular involvement by fibrovascular membranes or in patients with associated ERM, ILM peeling would be beneficial to prevent recurrence and to achieve improved anatomic remodelling [11].

Objectives

Primary Objective

1. To compare anatomical outcomes and macular morphological outcomes between patients undergoing vitrectomy with ILM peeling and those without ILM peeling for diabetic TRD.

Secondary Objective

1. To compare visual outcomes in patients undergoing vitrectomy with ILM peeling compared to those without ILM peeling for diabetic TRD.

Methodology

This was a prospective, randomized controlled trial conducted at Alshifa Trust Eye Hospital, Rawalpindi from 1st July 2024 to 31st December 2024. Eligible participants were enrolled using a simple random sampling technique. The required sample size was calculated to ensure adequate statistical power to detect significant differences in both visual and anatomical outcomes between the two groups. The sample size for this prospective randomized controlled trial was calculated using a two-arm design with 1:1 allocation, a two-sided significance level of 0.05, and a power of 80%. Based on published estimates and pilot observations, we assumed a clinically meaningful difference of 0.10 logMAR in best-corrected visual acuity (SD = 0.30) between the ILM peeling and non-peeling groups. Using the

standard two-means formula, the required sample size was 142 eyes per group. To account for an anticipated 10% attrition rate during follow-up, the final sample size was set at 158 patients per group, yielding a total of 316 participants for the study.

Inclusion Criteria:

- Adult patients (≥ 18 years) with a confirmed diagnosis of diabetic tractional retinal detachment (TRD).

Exclusion Criteria:

- Patients with glaucoma.
- Patients with hypertension and renal failure.
- Patients with any history of previous vitreoretinal surgery.
- Patients with a history of macular hole disease.
- Patients with any other concurrent retinal disorders.

Data Collection

Data were collected using a self-structured proforma. All patients underwent preoperative clinical evaluation in the vitreoretinal clinic, including best-corrected visual acuity (BCVA) assessment, contrast sensitivity, and baseline spectral-domain OCT scans (Spectralis OCT; Heidelberg Engineering, Germany). Participants were randomized into two groups:

- Group A: Primary vitrectomy with ILM peeling.
- Group B: Primary vitrectomy without ILM peeling.

Anatomical outcomes assessed included retinal reattachment rates and postoperative complications. Visual outcomes included BCVA and contrast sensitivity. Macular morphological

parameters were evaluated using OCT, including total macular volume, central macular volume, and central macular thickness. Postoperative clinical follow-ups were scheduled at 1 month and 6 months, with repeat OCT imaging and assessment of anatomical and functional outcomes.

Data Analysis

Data were analyzed using SPSS version 26. Descriptive statistics were presented as means and standard deviations for continuous variables and as frequencies and percentages for categorical variables. Inferential analysis was conducted using independent t-tests for continuous outcomes, chi-square tests for categorical outcomes, and multivariable regression analysis

where required to adjust for confounding factors. A p-value of <0.05 was considered statistically significant.

Results

Data were collected from 316 patients, the mean age was comparable (54.6 ± 8.9 vs. 55.1 ± 9.2 years), with the majority of patients being older than 50 years in both groups. Gender distribution was also similar, with slightly more males than females across the sample. Duration of diabetes averaged around 13 years in both groups, and most patients had longstanding disease (≥ 10 years). Baseline HbA1c levels showed that nearly 70% of patients in each group had poor glycemic control ($\geq 8\%$).

Table 1. Baseline Characteristics of Study Participants (n = 316)

Variable	Group A: ILM Peeling (n = 158)	Group B: No ILM Peeling (n = 158)
Mean Age (years)	54.6 ± 8.9	55.1 ± 9.2
Gender: Male n (%)	96 (60.8%)	92 (58.2%)
Gender: Female n (%)	62 (39.2%)	66 (41.8%)
Duration of Diabetes (yrs)	13.4 ± 4.8	13.1 ± 5.1
Baseline BCVA (logMAR)	1.32 ± 0.28	1.29 ± 0.31
Baseline CMT (μm)	486 ± 74	479 ± 70
Age < 50 years	52 (32.9%)	55 (34.8%)
Age ≥ 50 years	106 (67.1%)	103 (65.2%)
Duration of Diabetes < 10 yrs	41 (25.9%)	44 (27.8%)
Duration of Diabetes ≥ 10 yrs	117 (74.1%)	114 (72.2%)
HbA1c < 8%	48 (30.4%)	50 (31.6%)
HbA1c $\geq 8\%$	110 (69.6%)	108 (68.4%)

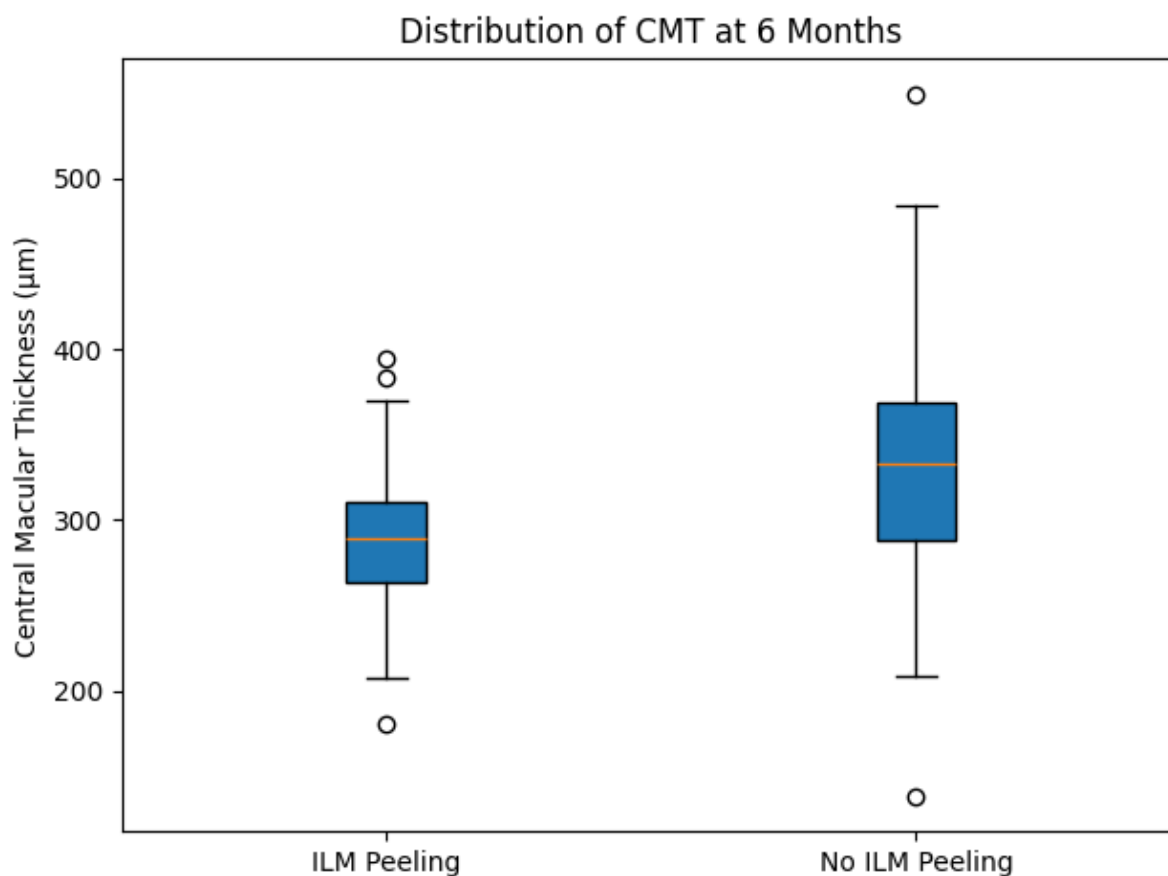
Patients undergoing ILM peeling achieved higher retinal reattachment rates (95.6% vs. 89.2%, $p = 0.04$). OCT analysis showed significantly better macular morphology in the peeling group, with lower central macular thickness ($291 \pm 42 \mu\text{m}$ vs.

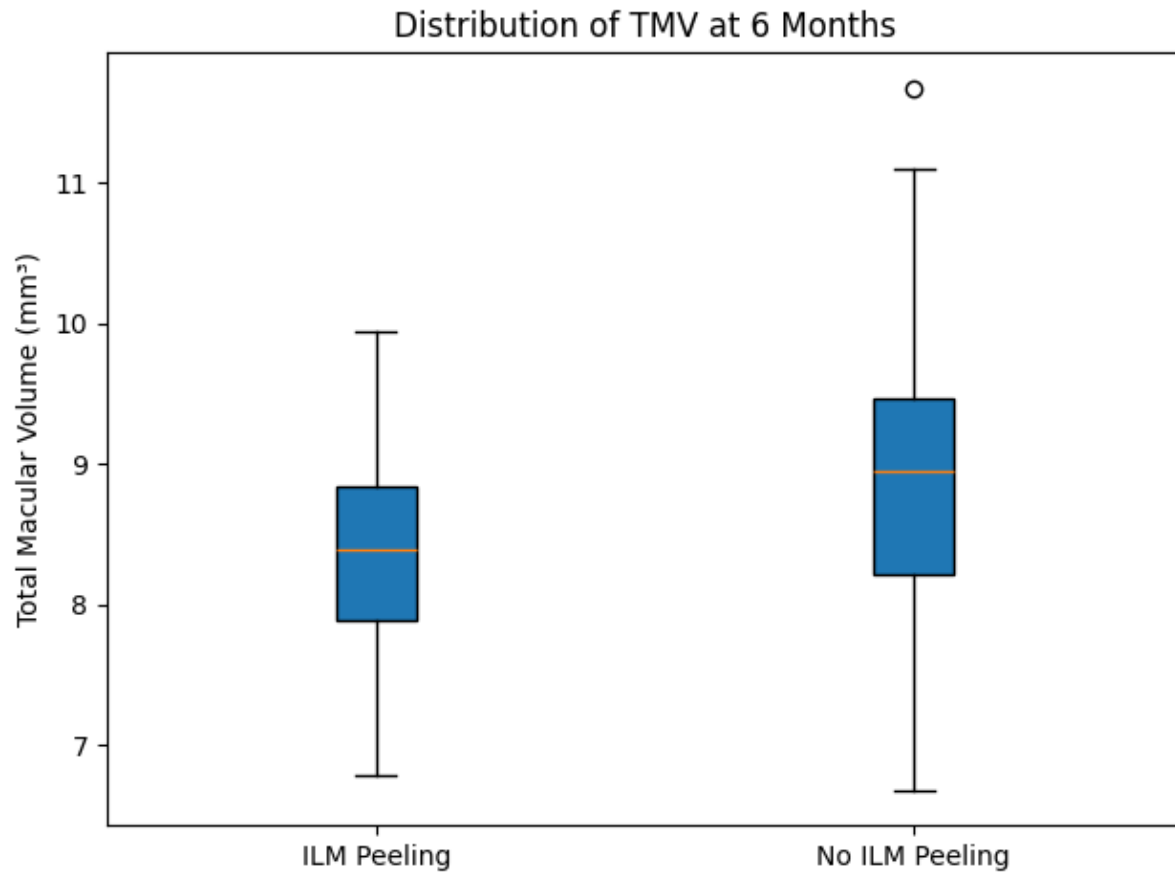
$326 \pm 58 \mu\text{m}$, $p < 0.001$) and reduced total macular volume ($8.4 \pm 0.7 \text{ mm}^3$ vs. $8.9 \pm 0.9 \text{ mm}^3$, $p = 0.002$). Importantly, postoperative epiretinal membrane (ERM) formation was much less frequent in the ILM peeling group (6.3% vs.

18.4%, $p = 0.001$), suggesting a protective effect of peeling against recurrent traction.

Table 2. Anatomical Outcomes at 6 Months

Outcome	Group A: ILM Peeling (n = 158)	Group B: No ILM Peeling (n = 158)	p-value
Retinal Reattachment Rate	151 (95.6%)	141 (89.2%)	0.04*
Central Macular Thickness (μm)	291 ± 42	326 ± 58	$<0.001^*$
Total Macular Volume (mm^3)	8.4 ± 0.7	8.9 ± 0.9	0.002*
Post-op ERM Formation n (%)	10 (6.3%)	29 (18.4%)	0.001*



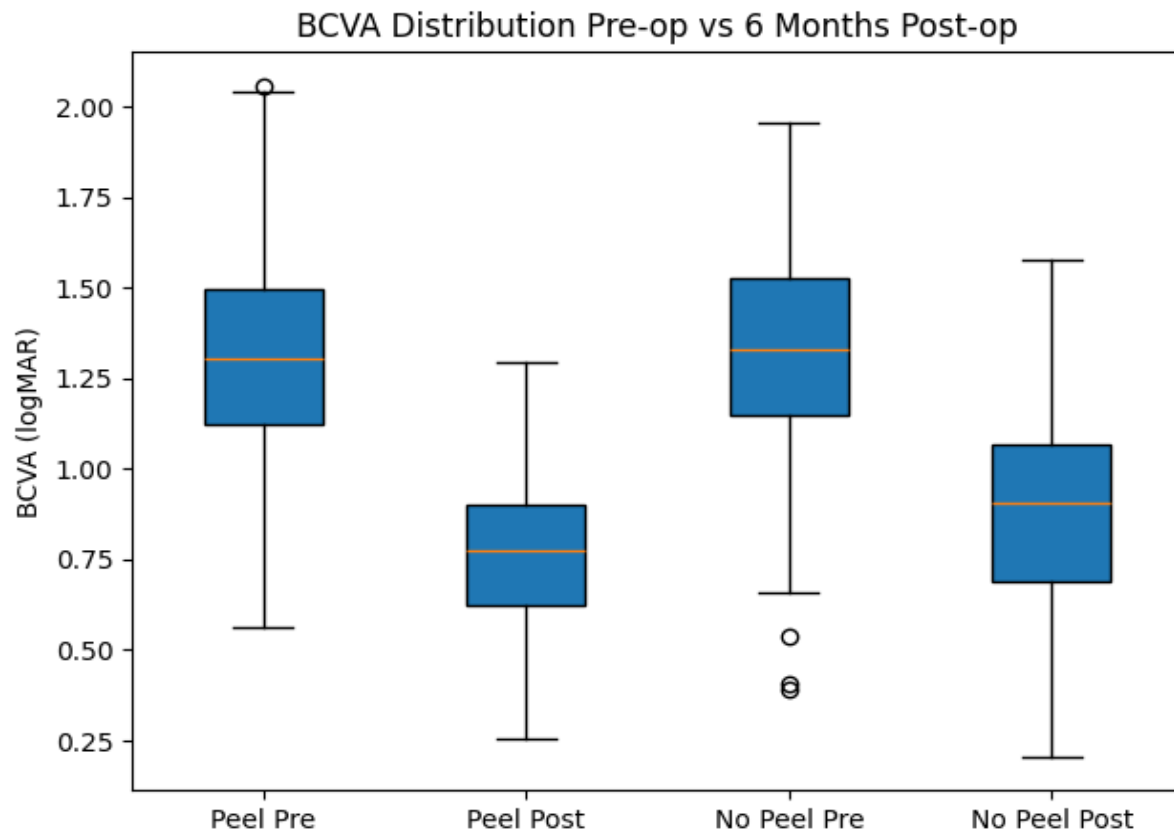


Visual recovery was superior in patients who underwent ILM peeling. Mean postoperative BCVA was significantly better in the peeling group (0.74 ± 0.22 logMAR vs. 0.88 ± 0.27 logMAR, $p = 0.003$), and the overall gain in vision

was greater (0.58 ± 0.20 vs. 0.41 ± 0.18 logMAR, $p = 0.002$). Contrast sensitivity also favored the peeling group (1.42 ± 0.15 vs. 1.31 ± 0.18 , $p = 0.01$), indicating not only better visual acuity but also improved quality of vision.

Table 3. Visual Outcomes at 6 Months

Outcome	Group A: ILM Peeling (n = 158)	Group B: No ILM Peeling (n = 158)	p-value
Post-op BCVA (logMAR)	0.74 ± 0.22	0.88 ± 0.27	0.003*
Mean Improvement in BCVA	0.58 ± 0.20	0.41 ± 0.18	0.002*
Contrast Sensitivity (log units)	1.42 ± 0.15	1.31 ± 0.18	0.01*



The rates of intraoperative and postoperative complications were similar between the two groups, with no statistically significant differences. Intraoperative retinal breaks (7.6% vs. 6.9%) and hemorrhage (9.5% vs. 10.8%) occurred at comparable frequencies. Postoperative vitreous hemorrhage was slightly

more frequent in the no-peel group (14.6% vs. 11.4%), while recurrent detachment was also somewhat higher without peeling (6.3% vs. 3.2%), though neither difference reached statistical significance. No cases of macular hole formation were observed in either group

Table 4. Intraoperative and Postoperative Complications

Complication	Group A: ILM Peeling (n = 158)	Group B: No ILM Peeling (n = 158)	p-value
Intraoperative Retinal Breaks	12 (7.6%)	11 (6.9%)	0.82
Intraoperative Hemorrhage	15 (9.5%)	17 (10.8%)	0.71
Postoperative Vitreous Hemorrhage	18 (11.4%)	23 (14.6%)	0.38
Recurrent Retinal Detachment	5 (3.2%)	10 (6.3%)	0.18
Macular Hole Formation	0	0	—

* $p < 0.05$ considered statistically significant

Discussion

This prospective randomized controlled trial assessed the impact of internal limiting membrane (ILM) peeling versus no peeling during vitrectomy for diabetic tractional retinal detachment (TRD). These data advocate that ILM peeling yielded better anatomical and functional results, such as a higher level of retinal reattachment, decreased thickness of the central macula, less postoperative epiretinal membrane (ERM) recurrence, and better best-corrected visual acuity (BCVA) and contrast sensitivity, with a statistically insignificant increase in intra- or postoperative complications. The greater peeling rate in the peeling group compared with the non-peeling group (95.6 % vs. 89.2 %) confirms the basic notion that the removal of ILM removes much of the residual tangential traction and provides a smoother retinal surface on which the anatomy can stabilize [12]. Such a benefit is especially applicable in diabetic eyes where secondary detachment and visual worsening are frequent due to the presence of gliotic membranes/recurrent ERMs. Similar or inferior results have been reported in observational series, but not all studies revealed a significant difference in those cases where baseline ischemia and macular involvement were severe [13]. The small but statistically significant improvement in BCVA noted in our study underscores the fact that functional recovery can occur not only when there is anatomic success but also when there is underlying photoreceptor health and the extent of macular ischemia, which may be population-specific [14].

Greater reduction in central macular thickness and total macular volume was also observed in the ILM peeling group, demonstrating a positive influence in the postoperative retinal remodeling. This is in line with past reports that diabetic

macular edema could be resolved through ILM removal and the scaffold effect that induces the formation of ERMs may be avoided [15]. The fact that the percentage of postoperative ERM formation was three times higher in the cutting group (6.3% to 18.4%) substantially evidences this hypothesis. Removal of the risk of ERM recurrence is clinically meaningful because repeat surgery is associated with increased risks and greater economic cost, given that patients have already developed systemic diabetic complications [16]. Our study also has visuals to support the functional advantage of ILM peeling. The average postoperative improvement in BCVA was higher in the group that underwent peeling (0.58 logMAR vs 0.41 logMAR) and contrast sensitivity significantly improved as well. These results indicate that in addition to structural recovery, microstructural retinal changes could contribute to worse function, which ILM peeling may address by diminishing microstructural alterations, producing subtle distortions that worsen visual quality [17]. It should be noted, however, that although the group that underwent peeling experienced superior results, the non-peeling group also demonstrated an important effect, which means that vitrectomy at a timely stage is seen as the ultimate bailout in the treatment of TRD. Concerning the safety aspect, we found there were no significant intraoperative complications like retinal breaks or hemorrhage that occurred more frequently during ILM peeling [18]. This is comforting, knowing the mythical dangers of peeling on unhealthy diabetic retinas. The lack of macular hole development, as well as of dye-related toxicity, points at the safety of the procedure as carried out with the use of modern surgical aids that include brilliant blue G dye and high-resolution visualization systems [19-21]. It should also be noted that ILM peeling extends

surgical time and also takes more advanced skills that may prove problematic in less resourceful settings. The findings have to be reported in the context of some limitations. A six-month follow-up will be sufficient to assess early anatomical and visual outcomes but may not suffice to assess long-term recurrence of ERM or late complications. A limitation of our findings is that we did not include patients with severe systemic illnesses like renal failure, and uncontrolled hypertension, which may not allow our results to be extrapolated on all cases of diabetic TRD seen in Pakistan. Lastly, as our study design minimized selection bias, OCT biomarkers, e.g., ellipsoid zone integrity or quantitative ischemia grading, were not provided, which could have further stratified the analysis of responders versus non-responders to ILM peeling.

Conclusion

It is concluded that internal limiting membrane (ILM) peeling during vitrectomy for diabetic tractional retinal detachment offers clear anatomical and functional advantages compared with surgery without peeling. Patients in the peeling group demonstrated higher retinal reattachment rates, greater reductions in central macular thickness, lower incidence of postoperative epiretinal membrane formation, and superior visual outcomes at six months, without a significant rise in intra- or postoperative complications. These findings suggest that ILM peeling can enhance both the structural stability and functional recovery of the retina in carefully selected patients.

References

1. Karahan E, Sahin Vural G, Girgin Y, Kayikcioglu OC, Guler C. Pars plana vitrectomy with and without internal limiting membrane peeling for diabetic patients with macular involved tractional retinal detachment. *Retina*. 2022 Sep 1;42(9):1737-44.
2. Pehlivanoglu S, Bektasoglu D, Ozcaliskan S, Alagoz C, Erdogan G, Artunay O. Effect of ILM Peeling on Anatomical and Visual Outcomes in Diabetic Tractional Retinal Detachment. *Beyoglu Eye Journal*. 2023;8(3):184.
3. Pehlivanoglu S, Bektasoglu D, Ozcaliskan S, Alagoz C, Erdogan G, Artunay O. Effect of ILM Peeling on Anatomical and Visual Outcomes in Diabetic Tractional Retinal Detachment. *Beyoglu Eye J*. 2023 Sep 13;8(3):184-192. doi: 10.14744/bej.2023.26986. PMID: 37766768; PMCID: PMC10521131.
4. Rashid, Ahmed M.a; Al Aswad, Mahmoud A.b; Awadallah, Ali K.a; Mohamed, Mohamed M.a. Effects of internal limiting membrane peeling versus non-internal limiting membrane peeling during vitrectomy for diabetic tractional retinal detachment on postoperative macular thickness, foveal contour, and formation of epiretinal membranes. *Journal of the Egyptian Ophthalmological Society* 117(1):p 50-58, January-March 2024. | DOI: 10.4103/ejos.ejos_54_23
5. Haseeb U, Haseeb M, Mahmood T. Primary Internal Limiting Membrane Peel and Its Effects on Epiretinal Membrane After Pars Plana Vitrectomy for Rhegmatogenous Retinal Detachment. 2024;40(3):310-314. Doi:10.36351/pjo.v40i3.1792
6. Sokol JT, Schechet SA, Rosen DT, Ferencsik K, Dawood S, Skondra D. Outcomes of vitrectomy for diabetic tractional retinal detachment in Chicago's county health system. *PLoS One*. 2019;14:e0220726. doi:10.1371/journal.pone.0220726.
7. World Health Organization. Consultation on development of standards for characterization of vision loss and visual functioning. Geneva: WHO; 2003. Available from: <https://apps.who.int/iris/handle/10665/68601>
8. Chen PL, Chen YT, Chen SN. Comparison of 27-gauge and 25-gauge vitrectomy in the management of tractional retinal detachment secondary to proliferative diabetic retinopathy. *PLoS One*. 2021;16(3):e0249139.

doi:10.1371/journal.pone.0249139.

9. Naruse Z, Shimada H, Mori R. Surgical outcomes of 27-gauge and 25-gauge vitrectomy day surgery for proliferative diabetic retinopathy. *Int Ophthalmol.* 2019;39(8):1973-80. doi:10.1007/s10792-018-1030-z.

10. Jung BJ, Jeon S, Lee K, Baek J, Lee WK. Internal limiting membrane peeling for persistent submacular fluid after successful repair of diabetic tractional retinal detachment. *J Ophthalmol.* 2019;2019:8074960. doi:10.1155/2019/8074960.

11. Awan MA, Hussain SZM, Shaheen F, Humayun MB, Zeb NT, Ayub B, et al. Efficacy and safety profile of 25-gauge pars plana vitrectomy in rhegmatogenous retinal detachment in Pakistan: a multicenter retrospective study. *Cureus.* 2022;14(3):e23437. doi:10.7759/cureus.23437.

12. Shunmugam M, Ang GS, Lois N. Giant retinal tears. *Surv Ophthalmol.* 2014;59(2):192-216. doi:10.1016/j.survophthal.2013.03.006.

13. Tayyab H, Jahangir S, Bukhari SHBUS, Jahangir S, Jawad AAM. Effects of ILM peeling on functional and structural outcomes of pars plana vitrectomy for rhegmatogenous retinal detachment. *J Sharif Med Dental Coll.* 2015;1(1):4-8.

14. Lee IJ, Benjamin JE, Ghorayeb GR. Incidence of epiretinal membrane formation after pars plana vitrectomy for giant retinal tear-associated retinal detachment. *Clin Ophthalmol.* 2023;17:1415-20. doi:10.2147/OPTH.S407699.

15. Takamidou Y, Mizuguchi T, Sakurai R, Sugimoto T, Tanikawa H, Horiuchi M. Risk factors for epiretinal membrane surgery after initial pars plana vitrectomy for rhegmatogenous retinal detachment. *Fujita Med J.* 2022;8(1):25-30. doi:10.20407/fmj.2020-027.

16. Kumar V, Dubey D, Kumawat D, Markan A, Chandra P, Chandra M, et al. Role of internal limiting membrane peeling in the prevention of

epiretinal membrane formation following vitrectomy for retinal detachment: a randomized trial. *Br J Ophthalmol.* 2020;104(9):1271-6. doi:10.1136/bjophthalmol-2019-315095.

17. Baudin F, Deschasse C, Gabrielle PH, Berrod JP, Le Mer Y, Arndt C, et al. Functional and anatomical outcomes after successful repair of macula-off retinal detachment: a 12-month follow-up of the DOREFA study. *Acta Ophthalmol.* 2021;99(7):e1190-7. doi:10.1111/aos.14777.

18. Ishida Y, Iwama Y, Nakashima H, Ikeda T, Emi K. Risk factors, onset, and progression of epiretinal membrane after 25-gauge pars plana vitrectomy for rhegmatogenous retinal detachment. *Ophthalmol Retina.* 2020;4(3):284-8. doi:10.1016/j.oret.2019.10.004.

19. Fallico M, Russo A, Longo A, Pulvirenti A, Avitabile T, Bonfiglio V, et al. Internal limiting membrane peeling versus no peeling during primary vitrectomy for rhegmatogenous retinal detachment: a systematic review and meta-analysis. *PLoS One.* 2018;13(7):e0201010. doi:10.1371/journal.pone.0201010.

20. Szigiato AA, Antaki F, Javidi S, Touma S, Duval R, Cordahi G, et al. Risk factors for epiretinal membrane formation and peeling following pars plana vitrectomy for primary rhegmatogenous retinal detachment: an OCT-guided analysis. *Int J Retina Vitreous.* 2022;8(1):70. doi:10.1186/s40942-022-00418-9.

21. Matoba R, Kanzaki Y, Doi S, Kanzaki S, Kimura S, Hosokawa MM, et al. Assessment of epiretinal membrane formation using en face optical coherence tomography after rhegmatogenous retinal detachment repair. *Graefes Arch Clin Exp Ophthalmol.* 2021;259(9):2503-12. doi:10.1007/s00417-021-05118-y.