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Myopic Vitreomacular Traction Syndrome

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ABSTRACT
Background: Myopic traction maculopathy (MTM), also known as myopic foveoschisis typically occurs in highly myopic eyes often leads to blindness. The pathologic features of foveoschisis may be alone or it may be associated with foveal detachment or macular hole.
Aim of the work: To assess the role of vitrectomy with internal limiting membrane (ILM) peeling in changing visual outcomes and optical coherence tomography (OCT) findings of the macula in patients with myopic vitreo-macular traction syndrome.
Design of the study: prospective Interventional case series.
Methodology: 19 high myopic eyes of 17 patients divided into 3 groups:
Group 1 (Foveoschisis only): (6 eyes)
Group 2 (foveoschisis and foveal detachment): (6 eyes)
Group 3 (foveoschisis, foveal detachment and macular hole): (7 eyes)
Results: In our study, the visual acuity significantly improved in all eyes at 6 months postoperatively. This was associated with significant reduction of central foveal thickness. There was statistically significant inverse correlation between changes in best corrected visual acuity (BCVA) and both basal refraction and basal BCVA. There was statistically significant direct correlation between changes in central foveal thickness (CFT) and basal refraction. On the other hand, there was significant inverse correlation between changes in CFT and basal CFT.
Conclusion: Visual improvement was better in foveoschisis with foveal detachment eyes than in foveoschisis or macular hole eyes.
Keywords: vitreomacular traction, high myopia, myopic foveoschisis, macular hole, BCVA, CFT, OCT, ILM, peeling, pars plana vitrectomy.

INTRODUCTION

Myopic traction maculopathy, also known as myopic foveoschisis, is a schisis-like thickening of the retina in eyes with high myopia and posterior staphyloma. The pathologic features may also include lamellar or full-thickness macular holes and shallow foveal detachment [1]. It may be caused by premacular traction of vitreous cortex or posterior ectasia that is associated with posterior staphyloma in high myopia, resulting in a "stretch retinoschisis". A degenerative process involving the posterior retina may be another factor associated with myopic foveoschisis [2].

It is better diagnosed by spectral domain optical coherence tomography (SD-OCT) which is a useful noninvasive modality for diagnosing and monitoring the morphologic recovery of the retina. In turn, for predicting the postoperative visual acuity [3]. The current approach in treating vitreoretinal interface is to perform a pars plana vitrectomy surgery if the severity of vision loss justifies the surgical risk [4]. The internal limiting membrane (ILM) is the anatomic site of pathology that mediates vitreo-macular traction forces to the retina [5].

PATIENTS AND METHODS

Patients

This prospective interventional case series study included 19 high myopic eyes of 17 patients. Their age ranged from 44–67 years old. These cases were collected from out-patient Ophthalmic Clinic of Ain Shams University Hospital during the period from Janurary, 2017 till September, 2017. The study was approved by the Ethics Board of Ain Shams University. The cases divided into 3 groups:

- **Group 1 (Foveoschisis):** (6 eyes) of 6 patients had foveoschisis only.
- **Group 2 (Foveal detachment):** (6 eyes) of 6 patients had foveoschisis and foveal detachment.
- **Group 3 (Macular hole):** (7 eyes) of 5 patients had foveoschisis, foveal detachment and macular hole.

Inclusion criteria

- Highly myopic patients with refractive error > -8.00 D.
- The vitreomacular traction seen by Optical 445445 Coherence Tomography (OCT).

Exclusion criteria

- Eyes with poor visual acuity due to diffuse macular chorioretinal atrophy or large Fuchs spots.
- Other retinal or macular diseases.
- Glaucoma.

The corresponding consent form followed the tenets of the Declaration of Helsinki. Informed consent was obtained from all participants before enrolment. All applicable institutional regulations concerning the ethical use of human volunteers were followed during this research.

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Methods

All cases underwent a complete ophthalmologic examination including best corrected visual acuity (BCVA) (Snellen equivalent), slit lamp examination, Intraocular pressure (IOP) measurement and biomicroscopy with a contact lens, indirect ophthalmoscopy and Spectral domain OCT (SD OCT). Cases were examined preoperatively, and on day 1, 2 weeks, 1, 3 and 6 months postoperatively.

Optical Coherence Tomography Scanning: with the Spectralis HRA+OCT system (version 3.2.1.0, Heidelberg Engineering, Inc., Heidelberg, Germany) was performed using the built-in 7-line raster scan protocol. Images were averaged from 100 frames for the purpose of noise reduction. The OCT scans were excluded if the image quality was less than 30 decibels. All study eyes were dilated with mydriatic eye drops before image acquisition. Patients were instructed to fixate on the intrinsic fixation target during the whole process of OCT scanning. If the patient was not fixating well and the center of image was not on center of the fovea, manual adjustment was performed.

Determination of retinal Thickness: The Spectralis SD-OCT data were analyzed on the Heidelberg Explorer. The internal limiting membrane (ILM), the external limiting membrane (ELM), the retinal pigment epithelium (RPE) and the outer boundary of choroid segmentation were manually set. The central foveal thickness was defined as the distance between the ILM and RPE at the foveal center.

Surgical technique

A 3-port 23-gauge pars plana vitrectomy was done under local anesthesia for all cases. Core vitrectomy then a posterior vitreous detachment was created by active suction with vitrectomy probe. Complete removal of the posterior hyaloid was assisted by triamcinolone acetonide (TA) (40 mg/mL, Kenacort; Bristol-Myers Squibb, New York, NY).

Internal limiting membrane (ILM) staining with brilliant blue G (Membrane Blue Dual, D.O.R.C. International) was done for 1 minute, followed by arcade-to-arcade ILM peeling using ILM forceps (D.O.R.C. international). Finally, fluid air exchange was done. Silicone oil was injected in some cases while remaining cases left air filled.

If visually significant cataract was present, phacoemulsification with implantation of intraocular lens in capsular bag was performed prior to vitrectomy. Postoperatively, topical antibiotic and steroids therapy was administered frequently over 4 weeks.

❖ Outcome measures

The decimal visual acuities were converted to the logarithm of the minimum angle of resolution (logMAR) units for statistical analyses. An improvement or worsening of visual acuity was defined as a change of 0.2 logMAR units and line improvement (Table 1). Reduction of central foveal thickness is documented as well as closure of macular hole and foveal attachment.

Table (1): BCVA expressed by LogMAR, Decimal and Snellen equivalent [6].

LogMAR	Snellen (Meter) 6/	Decimal
0.00	6.0	1.00
0.18	9.0	0.67
0.30	12.0	0.50
0.48	18.0	0.33
0.60	24.0	0.25
0.70	30.0	0.20
0.77	36.0	0.17
0.80	38.0	0.16
0.90	48.0	0.13
1.00	60.0	0.10
1.10	5/60	0.08
1.22	4/60	0.06
1.30	3/60	0.05
1.48	2/60	0.033
1.77	1/60	0.017
2.00	CF	0.010
3.00	HM	0.001

Statistical methods

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software version 22.0, IBM Corp., Chicago, USA, 2013.

Descriptive statistics were done for quantitative data as minimum and maximum of the range as well as mean ± SD (standard deviation) for quantitative normally distributed data, while it was done for qualitative data as number and percentage.

Inferential analyses were done for quantitative variables using independent t-test in cases of two independent groups with normally distributed data and paired t-test in cases of two dependent groups with normally distributed data in qualitative data, inferential analyses for independent variables were done using Fisher's Exact test for differences between proportions with small expected numbers. While correlations were done using Pearson correlation for numerical normally distributed data. The level of significance was taken at P value < 0.05 is significant, otherwise is non-significant.

The study was approved by the Ethics Board of Ain Shams University.

RESULTS

Nineteen eyes of 17 patients were included in this study. 64.7% of patients were females [11/17], while 35.3% were males [6/17]. The mean age was 54.4 ± 6.8 years old. The average refractive error was -17.0 ± 2.9 Diopters. 7 eyes were phakic, 10 eyes were pseudophakic and 2 eyes were aphakic. These cases had foveoschisis only 6/19 (31.6%) or with foveal detachment 6/19 (31.6%) or with macular hole 7/19 (36.8%). Vitrectomy with Internal limiting membrane (ILM) peeling was performed for all cases and silicon oil was injected in 42.1% (8/19) while remaining 57.9% (11/19) were air filled.

Along the follow up, there were no serious complications except single case developed retinal detachment, which reoperated with silicon oil injection then removed 3 months later, and another case had increased postoperative Intraocular pressure (IOP) that managed medically.The mean best-corrected visual acuity (BCVA) significantly reduced from 2.0 ± 0.7 LogMar (CF 50cm) preoperatively into 2.2 ± 0.6 LogMAR (CF 30cm) at 2 weeks postoperatively (p value = 0.009). Then it slightly improved into 2.1 ± 0.6 LogMar (CF 40cm) at 1 month postoperatively. Later on, the vision significantly improved into 1.4 ± 0.6 and 1.1 ± 0.5 at 3 and 6 months postoperatively respectively (2/60 and 5/60 respectively) (p value <0.001) (figure 1).

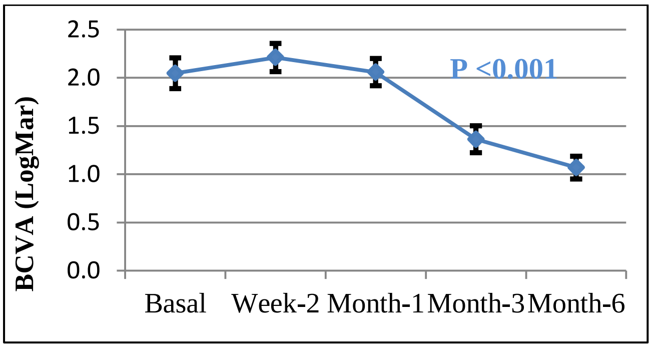

Figure (1): BCVA among the studied cases along the follow up period.

Mean Central foveal thickness significantly reduced from 952.1 ± 271.1 μm preoperatively to 529.0 ± 85.1, 365.3 ± 46.1, 278.9 ± 47.7 and 210.1 ± 23.5 μm at 2 weeks, 1, 3 and 6 months postoperatively (p value < 0.001). Figure (2) showed the change in the Central foveal thickness (CFT) along the follow up period.

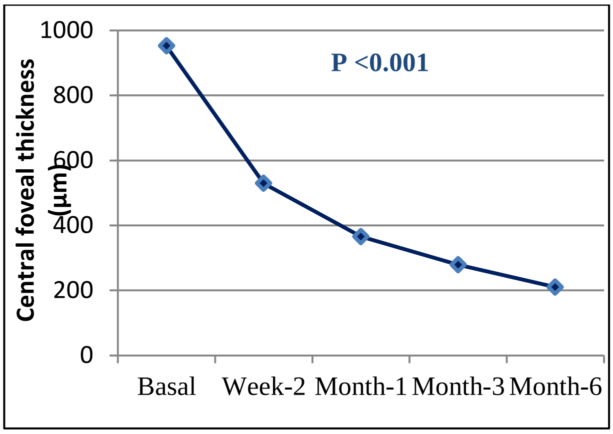

Figure (2): Central foveal thickness along the follow up period

As regards to OCT, the cases were divided into 3 groups; foveoschisis only (group-I) foveoschisis with foveal detachment (group-II) and Foveoschisis with foveal detachment and macular hole (group-III).

Group 2 (foveoschisis with foveal detachment) had older age than others. Higher myopia was seen in cases of group 1 (foveoschisis only).

Females were predominant of group 2 and 3 (foveoschisis with foveal detachment and with macular hole). Most of cases in group 2 and 3 were pseudophakic while 50% of group 1 was phakic. These differences were statistically insignificant as shown in table (2).

Table (2): Patients' ocular demographics in the studied groups.

Variables		Group-I (N=6)	Group-II (N=6)	Group-III (N=7)	P
Age (years) (Mean ± SD)		54.5±1.0	58.2±8.0	51.1±7.7	0.184
Refraction (Mean ± SD)		-18.2±1.7	-16.8±4.0	-16.1±2.9	0.485
Sex No (%)	**Male**	3 (50.0%)	2 (33.3%)	2 (28.6%)	#0.844
	Female	3 (50.0%)	4 (66.7%)	5 (71.4%)	
Eye No (%)	**Right**	1 (16.7%)	2 (33.3%)	4 (57.1%)	#0.427
	Left	5 (83.3%)	4 (66.7%)	3 (42.9%)	
BCVA (Mean ±SD)		1.8±0.4	1.9±0.9	2.4±0.7	0.173
Lens No (%)	**Phakic**	3 (50.0%)	1 (16.7%)	3 (42.9%)	#0.137
	Pseudophakic	1 (16.7%)	5 (83.3%)	4 (57.1%)	
	Aphakic	2 (33.3%)	0 (0.0%)	0 (0.0%)	
CFT (Mean ±SD)		955.8±306.9	1104.2±218.2	818.6±241.7	0.169

#Fisher's Exact test

All cases were injected with air except 85.7% (6/7) of group 3 (foveoschisis with macular hole) and 33.3% (2/6) of group 2 (foveoschisis with foveal detachment) had been injected with silicon. Single case in group 1 (foveoschisis) had retinal detachment at 1 month postoperatively and single case in group 3 (foveoschisis with macular hole) had elevated Intraocular pressure (IOP) which controlled medically.

In foveoschisis group, the mean Best corrected visual acuity (BCVA) slightly worsen from 1.8 ± 0.4 LogMAR (1/60) preoperatively to 1.9 ± 0.1 LogMAR (CF at 75cm) at 2 weeks. Then it gradually improved to 1.8 ± 0.2, 1.4 ± 0.3 and 1.1 ± 0.4 LogMAR (1/60, 3/60 and 5/60 respectively) at 1, 3 and 6 months postoperatively. These changes were statistically significant (P value = 0.008).

In foveoschisis with foveal detachment group, the mean BCVA showed slight worsening from 1.9 ± 0.9 LogMAR (CF at 75cm) preoperatively to 2.0 ± 0.8 LogMAR (CF at 50cm) at 2 weeks. Then it significantly improved to 1.8 ± 0.7, 1.0 ± 0.5 and 0.8 ± 0.4 LogMAR (1/60, 6/60 and 6/36 respectively) at 1, 3 and 6 months postoperatively (P value < 0.001).

In foveoschisis with foveal detachment and macular hole group, the mean BCVA significantly worsened from 2.4 ± 0.7 LogMAR (CF at 40cm) preoperatively to 2.7 ± 0.5 LogMAR (CF at 20cm) at 2 weeks. Then it slightly improved to 2.5 ± 0.6, 1.6 ± 0.8 and 1.3 ± 0.7LogMAR (CF at 30cm, 2/60 and 3/60 respectively) at 1, 3 and 6 months postoperatively. These changes were statistically insignificant (P value = 0.093). Figure (3).

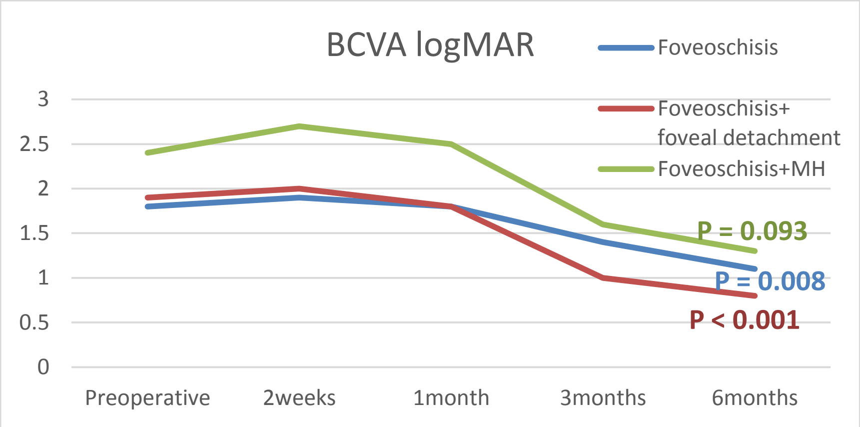

Figure (3): BCVA change in studied groups over follow up period.

At each visit, the mean BCVA was worse in foveoschisis with macular hole group than other groups. These differences were statistically significant at 2 weeks and 1 month postoperatively as shown in table (3).

Table (3): Comparison between groups regarding BCVA (LogMar)

Time	Group-I (N=6)	Group-II (N=6)	Group-III (N=7)	P
Levels				
Basal	1.8±0.4	1.9±0.9	2.4±0.7	0.173
Week-2	1.9±0.1	2.0±0.8	2.7±0.5	**0.039***
Month-1	1.8±0.2	1.8±0.7	2.5±0.6	**0.045***
Month-3	1.4±0.3	1.0±0.5	1.6±0.8	0.221
Month-6	1.1±0.4	0.8±0.4	1.3±0.7	0.365
Significant improvement	4 (66.7%)	6 (100.0%)	4 (57.1%)	#0.287
^P	**0.008***	**<0.001***	0.093	

#Fisher's Exact test, ^Paired t-test, *Significant

As regards to the mean change in visual lines improvement, it was higher in group 2 (foveoschisis with foveal detachment) (about 2.67 ± 1.21 lines) than group 1 (foveoschisis) (2.17 ± 1.47 lines) and group 3 (foveoschisis with macular hole) (1.57 ± 1.9 lines). But this difference was not statistically significant (P = 0.473) (figure 4).

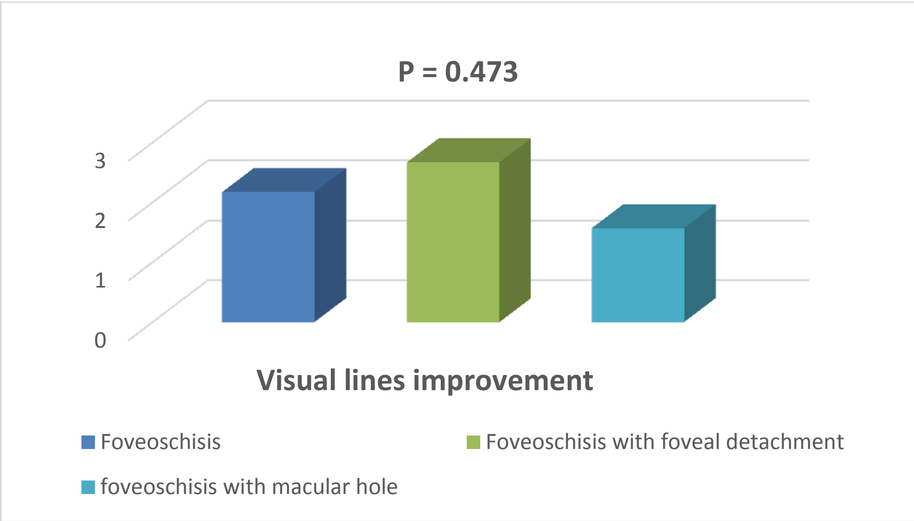

Figure (4): change in visual lines improvement

In all groups, the central foveal thickness significantly reduced to normal level at 6months postoperatively. These changes were statistically significant (P<0.001) as shown in table (4).

Table (4): Comparison between groups regarding central macular thickness (μm)

Time	Group-I (N=6)	Group-II (N=6)	Group-III (N=7)	P
Levels				
Basal	955.8±306.9	1104.2±218.2	818.6±241.7	0.169
Week-2	549.3±105.0	504.7±13.9	532.4±106.5	0.681
Month-1	359.2±59.2	374.0±53.7	363.0±30.5	0.859
Month-3	260.7±20.3	279.7±70.1	293.9±42.3	0.482
Month-6	207.5±8.2	188.3±17.2	231.0±19.0	**<0.001***
^P	**0.002***	**0.007***	0.054	

#Fisher's Exact test, ^Paired t-test, *Significant

There was insignificant difference between the 3 groups at each visit as regards the mean central foveal thickness (CFT) except at the end of the study when foveal detachment group has the lowest CFT (figure 5).

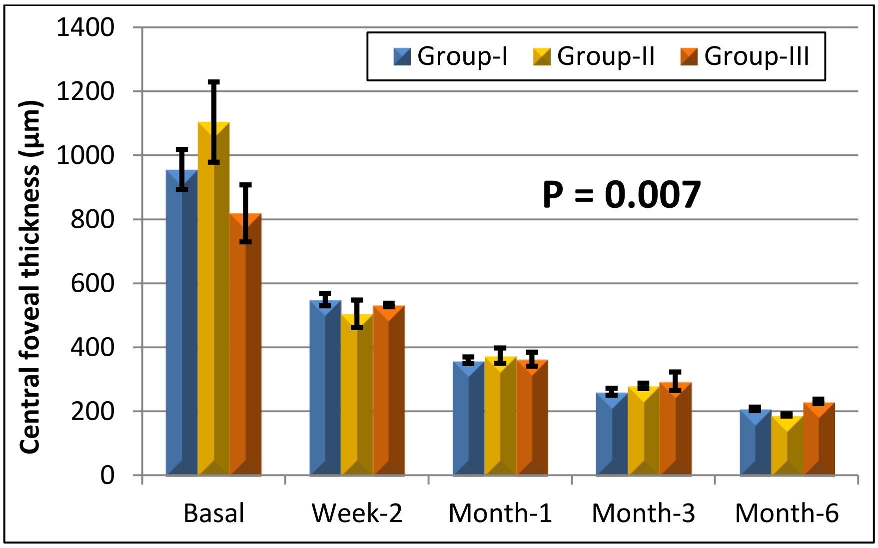

Figure (5): The CFT in studied groups along the follow up period.

Figures (6), (7) and (8) show examples of cases of different groups before the surgery and at the end of the study.

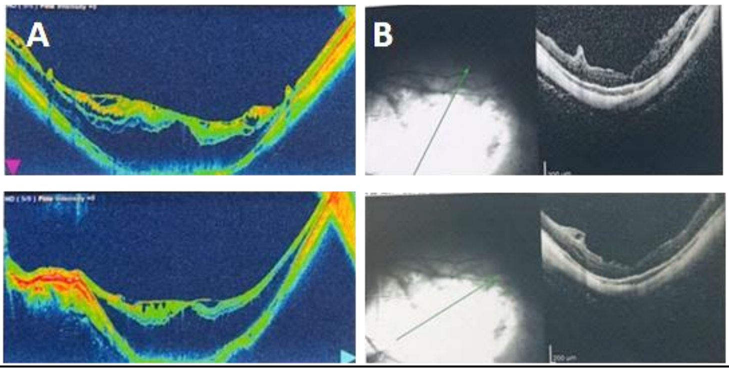

Figure (6): OCT of case No. 1, male patient of 55 years old with high myopia of -17 D, A: preoperative OCT showed myopic foveoschisis (group 1) with CFT of 900 µm and his BCVA 1/60 (1.77 LogMAR) **B:** postoperative OCT showed normal foveal contour with CFT of 215 µm and his BCVA was 6/60 (1 LogMAR)

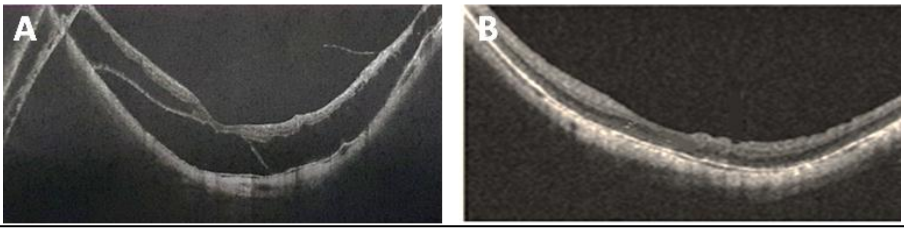

Figure (7): OCT of case No. 13, female patient of 60 years old with high myopia of -15 D, A: preoperative OCT showed myopic foveoschisis and foveal detachment (group 2) with CFT of 910 µm and his BCVA HM (3 LogMAR) **B:** postoperative OCT showed normal foveal contour with CFT of 200 µm and his BCVA was 5/60 (1.1 LogMAR)

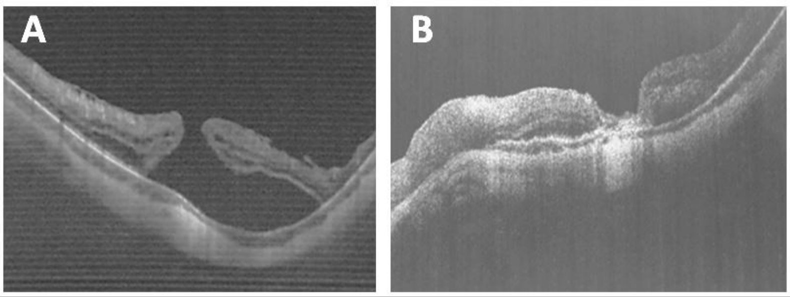

Figure (8): OCT of case No. 5, male patient of 50 years old with high myopia of -18 D, A: preoperative OCT showed myopic foveoschisis, foveal detachment and macular hole (group 3) with CFT of 900 µm and his BCVA CF (2 LogMAR) **B:** postoperative OCT showed normal foveal contour with CFT of 230 µm and his BCVA was 2/60 (1.48 LogMAR)

There was statistically significant inverse correlation between changes in BCVA and basal refraction and between change in BCVA and basal BCVA (r=-0.544, -0.69 respectively (p =0.016, 0.001 respectively) as shown in figure (9). This means less myopia and lower basal vision associated with more improvement of BCVA (figure 10).

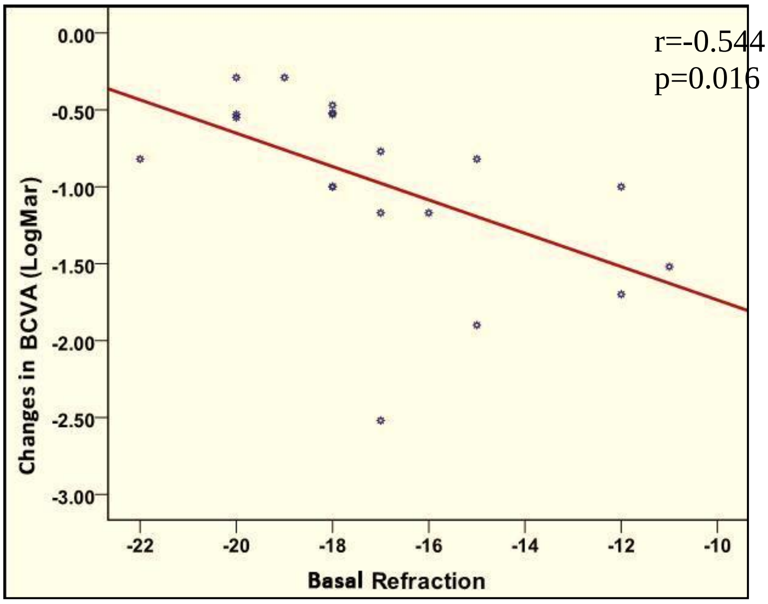

Figure (9): Inverse correlations between changes in BCVA and basal refraction

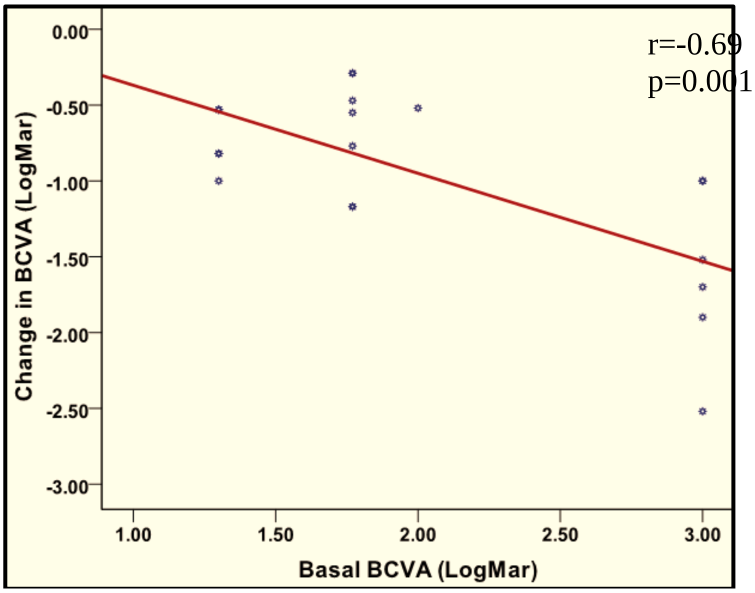

Figure (10): Inverse correlations between changes in BCVA and basal BCVA

There was also statistically significant direct correlation between change in CFT and basal refraction (r=0.664, p =0.002) as shown in figure (11). On the other hand, there was significant inverse correlation between change in CFT and basal CFT (r=-0.998, P<0.001) as shown in figure (12). This means less myopia and thicker basal macula associated with less reduction in CFT.

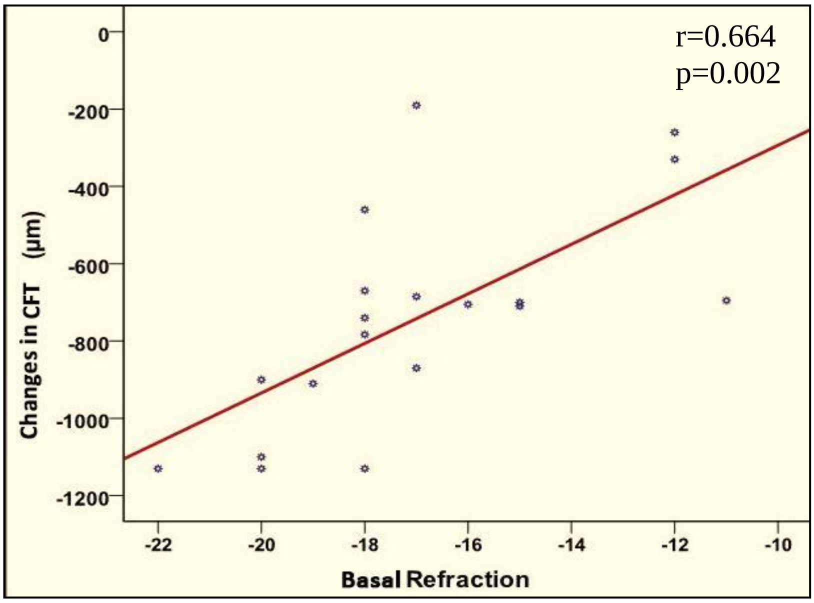

Figure (11): Direct correlations between changes in CFT and basal refraction

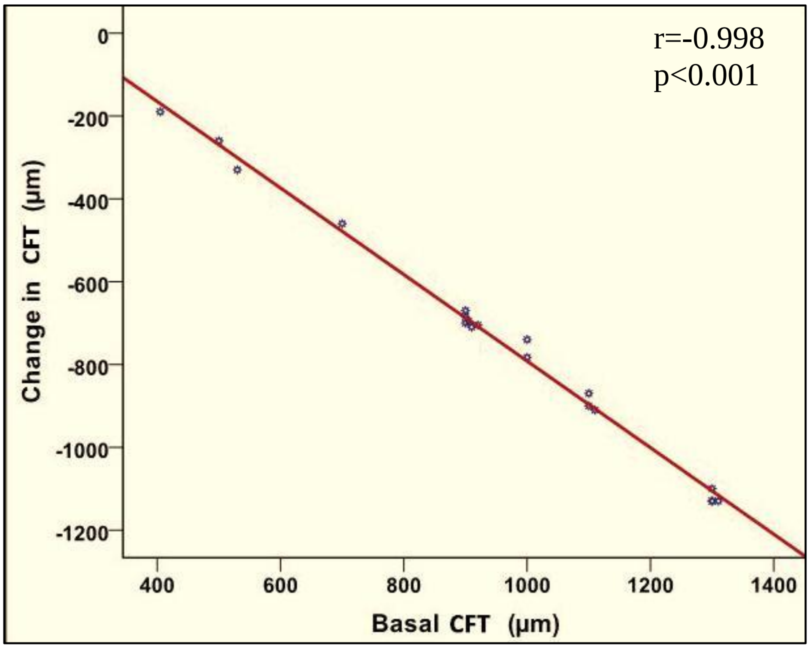

Figure (12): Inverse correlations between changes in CFT and basal CFT

DISCUSSION

Myopia causes various macular diseases, such as macular holes, foveoschisis, choroidal neovascularization, and chorioretinal atrophy, and often leads to blindness [7]. The prevalence of myopic foveoschisis has been reported to range from 8% to 34% in highly myopic eyes [8].

Based on the above considerations, a surgeon has 2 options when approaching a patient with visually significant myopic traction maculopathy. A minimalist approach seeks to identify and resolve surgically only the major traction mechanism, leaving the ILM intact. This approach has been supported by different studies [9-11], avoiding the risk of operative complications associated with ILM peeling, but this is unlikely to be successful in every case.

Alternatively, ILM peeling surgery has been approved to be effective procedure for every case with apparent preretinal traction. Different studies have supported this approach that has the highest single surgery success rate [12-18]. ***Sayanagi et al.*** **[19]** reported that 2 eyes with persistent myopic foveoschisis after primary vitrectomy without ILM peeling were successfully treated by reoperation including complete vitreous cortex removal and ILM peeling.

In the current study, we evaluated the improvement of vision and the anatomic change of the macula in nineteen eyes with myopic foveoschisis (with or without retinal detachment or macular hole) after vitrectomy and internal limiting membrane (ILM) peeling in all eyes.

As regards visual acuity, different studies reported about 50% of eyes achieved visual improvement greater than 0.3 logMAR (6/12) after vitrectomy with ILM peeling for foveoschisis cases [16,20], which was much greater than our results (5.26%).

Mikio et al. **[21]** reported that improvement of vision occurred in 80% of cases and remained unchanged in 20%, while in our study, the vision is improved in all cases.

In our study, we found that vision improved more than two lines in 78.9% (15/19) of foveoschisis cases versus 100% of ***Ikuno's*** cases [13]. This difference may be related to different preoperative refraction and BCVA (-17 D and 2 LogMAR in our study versus -14.4 D and 1.1 LogMAR in Ikuno's study respectively).

Ikuno et al. **[15]** reported that BCVA improved two lines or more in 81% of the foveal detachment group, 50% of the foveoschisis group, and 45% of the macular hole group at 12 months postoperatively. Visual improvement was significantly better in foveal detachment eyes ($P < 0.01$) than in foveoschisis ($P < 0.05$) or macular hole eyes ($P < 0.01$). In comparison to our study, BCVA improved two lines or more in 100% of the foveal detachment group, 66.7% of the foveoschisis group, and 71.4% of the macular hole group at 6 months postoperatively. Visual improvement was better in foveal detachment eyes than in foveoschisis or macular hole eyes but it was not statistically significant ($P = 0.473$).

Different studies [16, 22] reported that the postoperative BCVA was significantly better than the preoperative BCVA except in the early postoperative period, which was in agreement with our results.

On contrary, ***Guido et al.*** **[23]** reported non-significant improvement of BCVA (LogMAR) from baseline to 1 year postoperatively ($P = 0.095$).

As regards anatomical change, different studies reported a significant reduction of CFT at 6-12 months postoperatively, which was parallel to our results [13, 16, 22].

Fujimoto et al. **[22]** reported that the CFT significantly reduced from 470.8 ± 135.2 µm preoperatively to 218.7 ± 65.4 µm at 12 months postoperatively ($P < 0.0001$), with mean change of CFT of about 252.1 ± 127.0 µm. These findings were less than our results where the mean change of CFT was 740.1 ± 276.8 µm and the CFT significantly reduced from 952.1 ± 271.1µm preoperatively to 210.1 ± 23.5µm at 6 months postoperatively.

Kim et al. **[16]** reported that the mean CFT in cases with myopic foveoschisis significantly improved, from 573 ± 149 µm at baseline to 137 ± 45 µm at 12 months ($P = 0.012$), while our study reported a significant improvement of the CFT in foveoschisis group from 955.8 ± 306.9 µm at baseline to 207.5 ± 8 µm at 6 months ($P = 0.002$).

In our study, a complete resolution of myopic foveoschisis was achieved in all cases that was higher than ***Kim's*** study, ***Kobayashi and Kishi's*** study (88.9%), ***Guido's*** study (73.33%), and ***Ikuno's*** study (83%) [13, 16, 18, 23].

Mikio et al. [21] reported that successful retinal reattachment was achieved in 70% of eyes after the initial surgery and was achieved in 30% of eyes after additional procedures. The macular hole was anatomically closed in only 10% of eyes. In our study, 5.3% of our cases was detached and reoperated with silicone oil injection.

Ikuno et al. [15] found a statistically significant correlation between changes in BCVA and basal BCVA ($P < 0.01$) which was in agreement with our study.

In our study, we found statistically significant direct correlation between changes in CFT and basal refraction ($r=0.664$, $P=0.002$), but ***Fujimoto et al.*** [22] did not find any correlation between changes in CFT and basal refraction ($P = 0.54$).

In our study, we reported postoperative retinal detachment in one eye that was reoperated with silicon oil injection, and another case developed increased postoperative IOP that was managed medically. ***Kobayashi and Kishi*** [18] revealed that one eye developed a microhole at the macula during brushing of the retinal surface with a silicone tipped cannula for removal of premacular vitreous cortex. ***Mikio et al.*** [21] reported that postoperative enlargement of the macular hole was observed in seven eyes (70%). It was reported that a macular hole developed in 19.0% in ***Gao's*** study, 27.3% in ***Gaucher's*** study and 63.64% in ***Guido's*** study [4, 23, 24]. On the other hand, ***Ikuno et al.*** [13] reported that there are no complications developed.

CONCLUSION

Visual improvement was better in foveoschisis with foveal detachment eyes than in foveoschisis or macular hole eyes. Despite these results, it remained unclear whether ILM peeling was necessary for treating myopic foveoschisis and the ideal surgical approach remained uncertain. Therefore, further studies are needed to confirm the surgical benefits and to determine the incidence, risk factors, associations and natural course of myopic foveoschisis.

REFERENCES

1- **Panozzo G, Mercanti A (2004):** Optical coherence tomography findings in myopic traction maculopathy. Archives of ophthalmology, 122(10):1455-1460.
2- **Benhamou N, Massin P, Haouchine B, *et al.* (2002):** Macular retinoschisis in highly myopic eyes. Am J Ophthalmol., 133:794–800
3- **Akiba J, Konno S, Sato E, *et al.* (2000):** Retinal detachment and retinoschisis detected by optical coherence tomography in a myopic eye with a macular hole. Ophthalmic Surg Lasers, 31(3):240–242.
4- **Aniz G, Marc D (2014):** Introduction: Unmet medical need. In: Aniz G, Marc D, Arun DS, editors. Diseases of the vitreomacular interface, Essentials in ophthalmology. Heidelberg: Springer.
5- **Gao X, Ikuno Y, Fujimoto S, Nishida K (2013):** Risk factors for development of full-thickness macular holes after pars plana vitrectomy for myopic foveoschisis. Am J Ophthalmol., 155:1021-1027
6- **Nancy BC, Daniel K (2004).** Visual acuity (VA): Minimum legible using a LogMAR chart. In: Nancy BC, Daniel K, editors. Clinical Procedures for Ocular Examination. U.S.A: McGraw Hill..
7- **Silva R (2012):** Myopic maculopathy: a review. Ophthalmologica, 228(4):197-213
8- **Wu PC, Chen YJ, Chen YH, *et al.* (2009):** Factors associated with foveoschisis and foveal detachment without macular hole in high myopia. Eye, 23(2):356–361
9- **Kwok AK, Lai TY, Yip WW (2005):** Vitrectomy and gas tamponade without internal limiting membrane peeling for myopic foveoschisis. Br J Ophthalmo.l, 89(9):1180–1183
10-**Spaide RF, Fisher Y (2005):** Removal of adherent cortical vitreous plaques without removing the internal limiting membrane in the repair of macular detachments in highly myopic eyes. Retina, 25:290–295
11-**Yeh SI, Chang WC, Chen LJ (2008):** Vitrectomy without internal limiting membrane peeling for macular retinoschisis and foveal detachment in highly myopic eyes. Acta Ophthalmol., 86(2):219 –224
12-**Hirakata A, Hida T (2006):** Vitrectomy for myopic posterior retinoschisis or foveal detachment. Jpn J Ophthalmol., 50(1): 53–61
13-**Ikuno Y, Sayanagi K, Ohji M, *et al.* (2004):** Vitrectomy and internal limiting membrane peeling for myopic foveoschisis. Am J Ophthalmol., 137:719–24
14-**Ikuno Y, Gomi F, Tano Y (2005):** Potent retinal arteriolar traction as a possible cause of myopic foveoschisis. Am J Ophthalmol. ,139(3):462– 467
15-**Ikuno Y, Sayanagi K, Soga K, Oshima Y, Ohji M, Tano Y (2008):** Foveal anatomical status and surgical results in vitrectomy for myopic foveoschisis. Jpn J Ophthalmol., 52(4): 269–276
16-**Kim KS, Lee SB, Lee WK (2012):** Vitrectomy and internal limiting membrane peeling with and without gas tamponade for myopic foveoschisis. Am J Ophthalmol., 153(2):320–326
17-**Kanda S, Uemura A, Sakamoto Y *et al*. (2003):** Vitrectomy with internal limiting membrane peeling for macular retinoschisis and retinal detachment without macular hole in highly myopic eyes. Am J Ophthalmol., 136:177–80
18-**Kobayashi H, Kishi S (2003):** Vitreous surgery for highly myopic eyes with foveal detachment and retinoschisis. Ophthalmology, 110: 1702–1707
19-**Sayanagi K, Ikuno Y, Tano Y (2006):** Reoperation for persistent myopic foveoschisis after primary vitrectomy. Am J Ophthalmol., 141(2):414–417
20-**Ishikawa F, Ogino N, Okita K, Atarashii Ganka *et al.* (2001):** Vitrectomy for macular detachment without macular hole in highly myopic eyes [in Japanese]. *Eye*, 18:953–956
21-**Mikio I, Toyohisa Y, Kenji M *et al*. (2003):** Surgical management of retinal detachment associated with myopic macular hole: anatomic and functional status of the macula. American Journal of Ophthalmology, 136 (2): 277-284
22-**Fujimoto S, Ikuno Y, Nishida K (2013):** Postoperative optical coherence tomographic appearance and relation to visual acuity after vitrectomy for myopic foveoschisis. Am J Ophthalmol. , 156: 968–973
23-**Guido R, Andrea MC, Romolo F *et al*. (2001):** Evaluation of primary surgical procedures for retinal detachment with macular hole in highly myopic eyes. A randomized comparison of vitrectomy versus posterior episcleral buckling surgery. Ophthalmology ,108:2258–2265
24-**Gaucher D, Haouchine B, Tadayoni R *et al*. (2007):** Long-term follow-up of high myopic foveoschisis: natural course and surgical outcome. Am J Ophthalmol., 143(3):455–462.