Vitrectomy for Myopic Traction Maculopathy

Article *in* Archives of Ophthalmology · July 2007

Impact Factor: 4.4 · DOI: 10.1001/archopht.125.6.767 · Source: PubMed

2 authors:

Giacomo Panozzo
Azienda ULSS numero 22 Bussolengo

Andrea Mercanti
Azienda Ospedaliero Universitaria Santa Mar…

Vitrectomy for Myopic Traction Maculopathy

Giacomo Panozzo, MD; Andrea Mercanti, MD

Objective: To describe the results of vitrectomy in highly myopic eyes affected by a form of posterior vitreous traction termed *myopic traction maculopathy* (MTM).

Methods: In this retrospective case series, 24 highly myopic eyes with MTM underwent vitrectomy and release of vitreoretinal traction without final fluid/gas exchange. Nine eyes (37.5%) received a combined phacovitrectomy. Mean patient age was 58 years, mean refractive error was −16.8 dioptric spherical equivalent, and preoperative visual acuity ranged from 20/400 to 20/32 (mean, 20/80). Mean follow-up was 29.6 months.

Results: Twenty-three (95.8%) of 24 eyes had complete and stable resolution of MTM after a mean of 4.4 months. Mean visual improvement was 2.5 Snellen lines (range, 0 to 6 lines). Five eyes (20.8%), despite achieving complete retinal flattening, developed a macular hole that did not progress to macular detachment during follow-up.

Conclusions: Vitrectomy without fluid/gas exchange leads to stable resolution of MTM and good visual improvement. Posterior retinal detachment probably precedes macular hole formation in highly myopic eyes.

Arch Ophthalmol. 2007;125:767-772

The posterior pole of highly myopic eyes is a unique environment in which chorioretinal stretching and atrophy from marked scleral concavity and staphyloma are often associated with persistent vitreoretinal adhesions.[1-6] The formation of macular hole and posterior retinal detachment are well-known advanced consequences of this unstable condition. The early stages of such damage, however, are barely detectable by common diagnostic tools because of the peculiar fundus picture of high myopia and are apparent only using the high imaging resolution of optical coherence tomography (OCT).[3,7]

The use of OCT in large case series of high myopia has recently demonstrated that unsuspected posterior retinal anomalies affect up to one third of these eyes.[3,8,9] As we found in a large case series of 125 eyes,[9] the damage varies from retinal thickening to focal or diffuse retinoschisis and can be associated with shallow retinal detachment. This condition is particular to high myopia and must be considered as a separate cause of visual impairment in these eyes.

Most authors believe that vitreous traction is the main cause of this disease,[3,5,10] and this appears to be confirmed by histological studies.[4] The presence of posterior staphyloma with consequent retinal stretching, particularly evident at the site of nonextensible retinal vessels, is considered as a secondary factor.[7,11,12] The pivotal role of vitreous traction is confirmed by the good results obtained by vitrectomy with gas tamponade and facedown positioning in cases of myopic foveal retinoschisis.[10,13-17]

In this article, we describe the results of vitrectomy on, to our knowledge, the largest case series of myopic foveal retinoschisis (24 cases), studied for up to 5 years. In contrast to other authors, we demonstrate how the simple release of vitreoretinal traction without using any vitreal substitute can slowly reverse macular damage and lead to stable retinal anatomy.

Since we, as well as all other authors, obtained a visual improvement that should be not possible in cases of true separation between retinal layers, we believe that this condition is not a retinoschisis but instead a form of retinal edema from traction. We therefore propose, as in our previous article on the subject,[9] the more appropriate name of myopic traction maculopathy (MTM) to define the disease.

METHODS

From April 2001 to May 2005, vitrectomy was performed at our institution on 38 highly

Author Affiliations: Theia, Fondazione per l'Oftalmologia, Verona, Italy.

Table 1. Characteristics and Surgical Results

Eye/Patient Sex/ Patient Age, y	SE	PVA	PVD	M	Surgery	Follow-up, mo	Flat	Lines Gained	Surgical Results
1/F/34	–15	20/50	No	2	PPV	19	3	3	Foveal reattachment
2/M/40	–13	20/100	No	4	PPV	15	6	0	Hole
3/F/42	–19	20/400	Yes	4	PPV	36	1	0	Hole
4/F/58	–16	20/100	Yes	4	PPV	25	4	2	Foveal reattachment
5/F/56	–18	20/400	Yes	4	PPV	48	5	1	Hole
6/F/65	–18	20/200	Yes	2	PPV	17	2	2	Foveal reattachment
7/F/62	–18	20/100	Yes	3	PPV	57	9	5	Foveal reattachment
8/F/62	–19	20/400	Yes	4	PPV	59	No	0	Surgery aborted
9/F/69	–21	20/100	Yes	4	PPV	17	4	1	Foveal reattachment
10/F/55	–14	20/100	Yes	2	PPV	10	12	2	Foveal reattachment
11/F/71	–17	20/50	No	3	PPV	43	1	2	Foveal reattachment
12/F/38	–14	20/40	No	2	PPV	32	1	0	Foveal reattachment
13/F/72	–14	20/200	Yes	2	PPV	15	3	0	Foveal reattachment
14/F/32	–16	20/32	No	3	PPV	9	1	0	Foveal reattachment
15/F/41	–12	20/32	No	2	PPV	48	3	3	Foveal reattachment
PPV mean results	–16.3	20/80		3		30	3.9	1.8	
16/F/66	–18	20/50	Yes	3	PPV + phaco	9	7	0	Hole
17/F/66	–19	20/400	Yes	3	PPV + phaco	8	2	4	Foveal reattachment
18/F/32	–12	20/100	No	2	PPV + phaco	36	11	5	Foveal reattachment
19/M/44	–16	20/63	No	2	PPV + phaco	40	3	3	Foveal reattachment
20/M/44	–18	20/63	No	2	PPV + phaco	39	3	3	Foveal reattachment
21/F/79	–15	20/200	No	4	PPV + phaco	10	7	0	Hole
22/F/79	–13	20/32	Yes	4	PPV + phaco	8	5	3	Foveal reattachment
23/F/77	–26	20/400	No	3	PPV + phaco	52	3	6	Foveal reattachment
24/F/77	–22	20/200	No	3	PPV + phaco	53	5	6	Foveal reattachment
PPV+ phaco mean results	–17.6	20/80		2.9		28.3	5.1	3.3	
Total mean results	–16.8	20/80		2.7		29.6	4.4	2.5	

Abbreviations: flat, months for retinal flattening; M, myopic changes at posterior pole according to Avila et al[18] classification (see Table 2); phaco, phacovitrectomy; PVA, preoperative visual acuity; PVD, posterior vitreous detachment; PPV, pars plana vitrectomy; SE, spherical equivalent in diopters.

Table 2. Avila et al[18] Classification of Myopia

Grade	Characteristics
M0	Normal-appearing posterior pole
M1	Choroidal pallor and tessellation
M2	Choroidal pallor and tessellation with posterior pole staphyloma
M3	Choroidal pallor and tessellation with posterior pole staphyloma and lacquer cracks
M4	Choroidal pallor and tessellation with posterior pole staphyloma and lacquer cracks and focal areas of deep choroidal atrophy
M5	Posterior pole showing large geographic areas of deep choroidal atrophy (bare sclera)

myopic eyes with MTM involving the fovea. Because these eyes may have had concomitant causes of visual deficiency, vitrectomy was selected only when MTM was judged as (1) the main cause of a recent decrease in visual function; (2) an important cause of a stable visual impairment; and (3) an unstable condition jeopardizing the remaining vision. We therefore excluded from surgery eyes with poor visual acuity due to diffuse macular chorioretinal atrophy or large Fuchs spots, where no significant visual improvement could be expected. To better compare our surgical case series with the others previously published that only considered eyes with so-called foveal retinoschisis,[3,10,13] only eyes with this form of the disease were included, while different features of MTM[9] (retinal thickening with tangential or anteroposterior traction, isolated shallow foveal detachment, or MTM threatening but not involving the fovea) were excluded from the present series.

A total of 24 eyes were included in this study (**Table 1**). The severity of myopic changes at the posterior pole was graded according to the 5-step classification proposed by Avila et al[18] as shown in **Table 2**. Patient age ranged from 32 to 79 years (mean, 58 years). Five patients underwent surgery in both eyes. Seventeen patients were women (21 eyes [87.5%]) and 2 were men (3 eyes [12.5%]). Refractive error ranged from −12 dioptric spherical equivalent to −26 dioptric spherical equivalent (mean, −17 dioptric spherical equivalent), with best-corrected visual acuity from 20/400 to 20/32 Snellen lines (mean, 20/100). Eleven eyes were pseudophakic and the remaining 13 eyes were phakic. The lens status was classified following Lens Opacities Classification System III classification[19] and ranged from N0-C0 to N3-C3. There was no significant difference in preoperative visual acuity between phakic and pseudophakic eyes. The extent of myopic changes at the posterior pole (Table 2) ranged from M2 to M4. A clearly detectable posterior vitreous detachment (PVD) with fluctuating posterior hyaloid or Weiss ring was visible at biomicroscopy in 14 eyes (58%).

At OCT examination, all 24 eyes had foveal retinal swelling with apparent separation between retinal layers (**Figure 1**), combined with shallow foveal detachment in 5 eyes (**Figure 2**). None of these eyes had undergone any retinal surgery in the past.

Follow-up ranged from 8 to 59 months (mean, 29.3 months) Of 24 eyes, 9 received a combined phacovitrectomy for refractive purposes, and the analysis of visual results in these eyes has been considered separately.

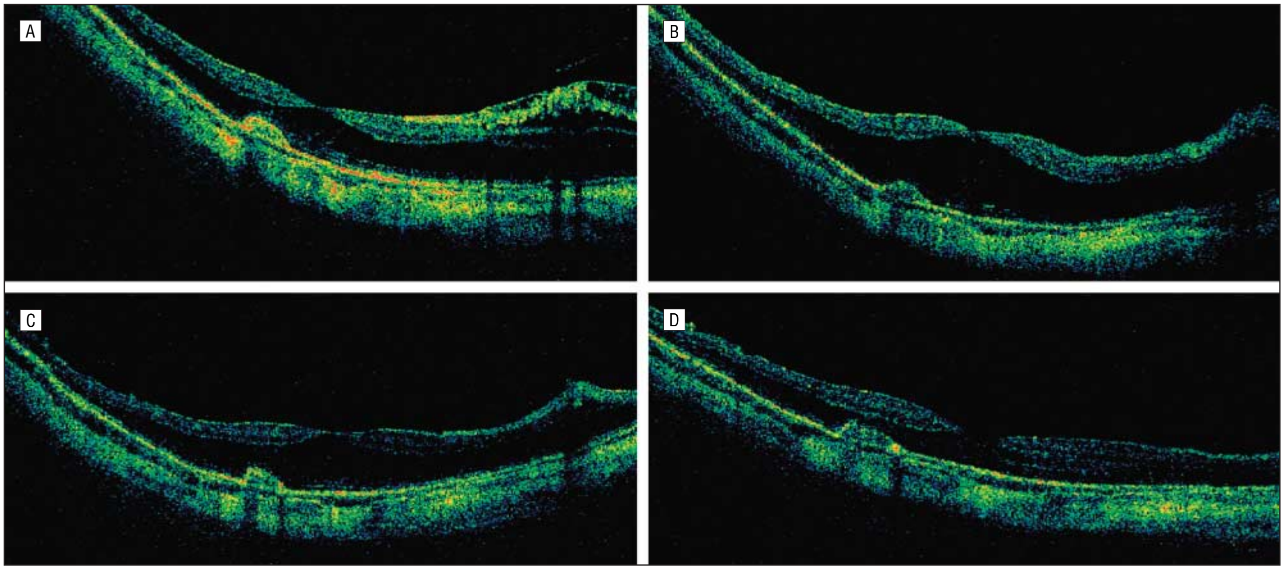

Figure 1. Pars plana vitrectomy (PPV) for myopic traction maculopathy (MTM). A, Preoperative image showing MTM with epiretinal and vitreoretinal traction. A juxtafoveal inactive choroidal neovascularization previously treated with photodynamic therapy is visible. Visual acuity is 20/50. B, One month after PPV, retinal thickening is still present but traction is no longer visible. Visual acuity is still 20/50. C, Two months after surgery, retinal thickening is reduced, with a peripheral retinal microfold on the right. Visual acuity is 20/50. D, Four months after surgery, MTM is completely resolved. Visual acuity is 20/32.

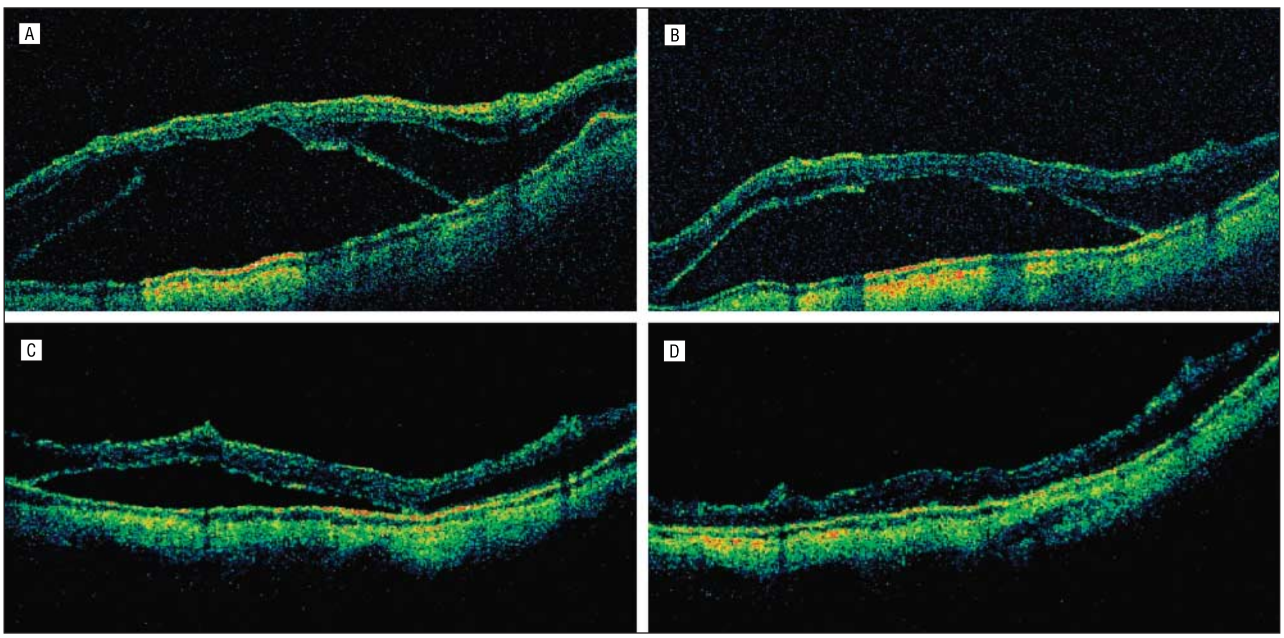

Figure 2. Vitrectomy for myopic traction maculopathy (MTM) associated with shallow retinal detachment. A, Preoperative image showing shallow retinal detachment with lateral retinal thickening. No traction is visible. Visual acuity is 20/400. B, Two months after pars plana vitrectomy, MTM is reduced. Visual acuity is 20/400. C, Five months after surgery, the macular morphology with retinal microfolds is further improved. Visual acuity is 20/80. D, Eleven months after surgery, MTM resolved while retinal microfolds persisted. Visual acuity improved to 20/63.

OCT EXAMINATION TECHNIQUE

All eyes were tested with Stratus OCT software version 2 or 3 (Carl Zeiss Meditec, Dublin, Calif) using the "radial lines" mode with the patient fixating on the central fixation light. With this modality, 6 consecutive scans were radially oriented every 30° to create a general picture of the entire posterior pole. This scan was repeated with scan lengths of 6 and 9 mm in an effort to visualize the origin of the traction, often at the borders of the staphyloma. Finally, the rough scans were directly analyzed without software processing to avoid alterations of the eye profile or loss of visibility of small anomalies.

SURGICAL TECHNIQUE

A standard 20-gauge 3-port pars plana vitrectomy was performed in all eyes under local anesthesia. The central vitreous core was first removed, paying particular attention to visualizing any vitreoretinal adhesions (focal or diffuse) and detecting or generating a fluctuating and free posterior hyaloid membrane (complete PVD) with active suction. Vitrectomy was then extended to the midperiphery without attempts to reach the vitreous base.

All focal or diffuse vitreoretinal adhesions and epiretinal membranes were removed, if possible, to the borders of the

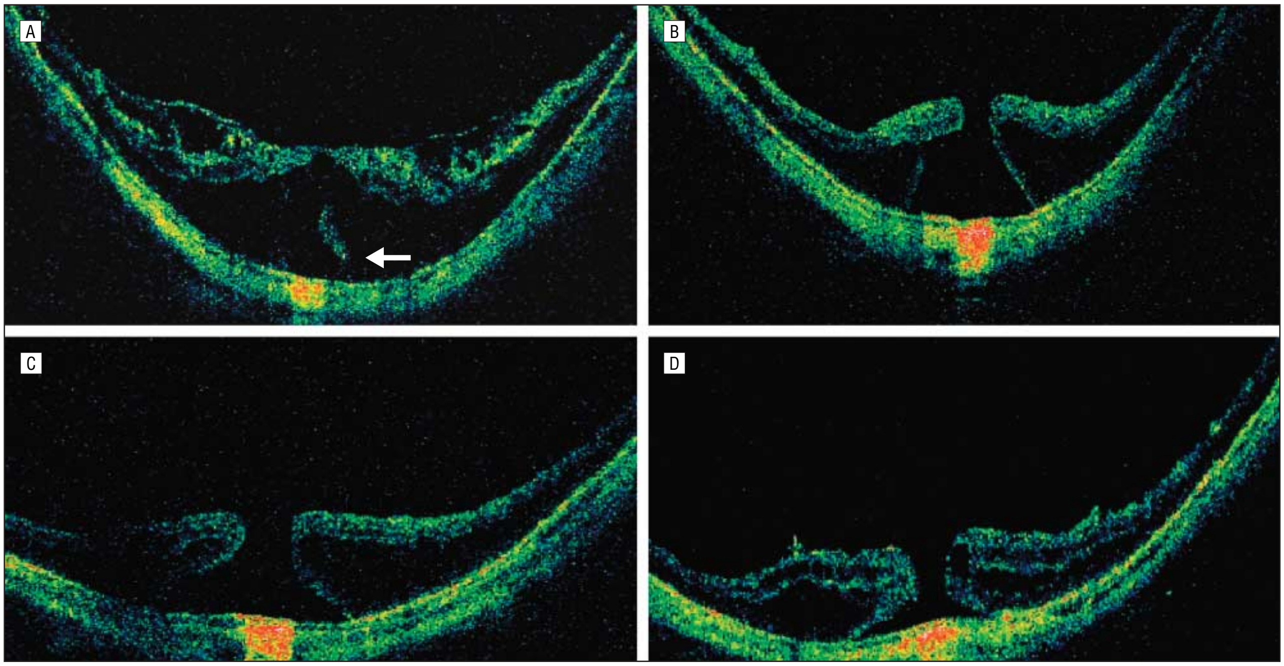

Figure 3. Postoperative development of a full-thickness macular hole. A, Preoperative image showing macular thickening with a subfoveal retinal detachment (arrow) associated with tangential epiretinal traction. Visual acuity is 20/400 with a large central scotoma. B, One month after pars plana vitrectomy, the epiretinal traction is no longer visible, but the retina is still thickened. From the thin inner foveal layer present before surgery, a macular hole developed. Visual acuity is 20/400. C, Three months after surgery, thickening is reduced and the visual acuity is improved to 20/200. D, Five months after surgery, the hole is still flat and the retinal thickening is reducing. Visual acuity is 20/200 with a marked reduction of the central scotoma.

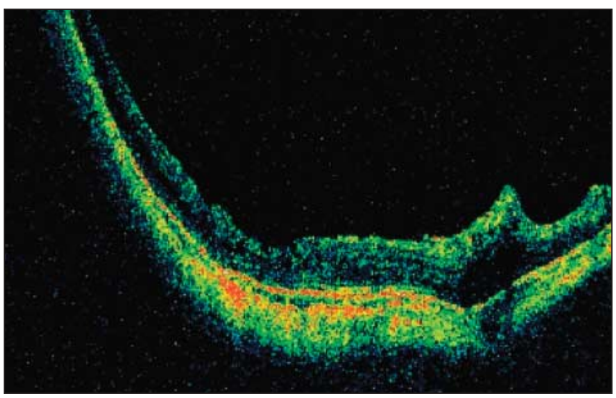

Figure 4. A retinal microfold after surgery. Most of these anomalies develop or increase after surgery in the site of nonextensible small retinal arteries.

staphyloma, often with the help of triamcinolone acetate. In many cases, multiple injections of dye showed a multilayered vitreous cortex variably adherent to the retina. The internal limiting membrane (ILM), stained with indocyanine green (5 mg/mL), was finally removed in the macular area. Neither gas nor any other form of vitreous tamponade was used.

All patients were followed up every 2 months with complete ophthalmic evaluation and OCT imaging until the retina was completely flat, and every 6 months thereafter. Informed consent was obtained from all patients, and data collection was performed in accordance with all country laws.

STATISTICAL ANALYSIS

The mean and median preoperative and postoperative values of best-corrected visual acuity were compared using the nonparametric Wilcoxon signed rank test, paired *t* test, and sign test of matched pairs.

RESULTS

ANATOMICAL RESULTS

In 23 (95.8%) of 24 eyes, total resolution of MTM was obtained in a mean time of 4.4 months (range, 1 to 12 months) (Figure 1 and Figure 2). Four of the 5 eyes with associated shallow retinal detachment and 1 eye with simple retinoschisis, though achieving complete retinal flattening, developed a macular hole during the sealing process (**Figure 3**). One eye remained unchanged. In this eye, complete peeling was aborted because of the strength of the traction and surgical maneuvers that jeopardized retinal integrity. In 18 eyes (78.6%), retinal microfolds at the arterial crossing were visible after surgery or improved as compared with the preoperative condition (**Figure 4**). All 23 eyes with a flattened retina remained stable during follow-up. The 5 eyes with a macular hole remained flat and never developed retinal detachment. None of the eyes developed retinal detachment or other intraoperative or postoperative vision-threatening complications. During follow-up, 2 phakic eyes developed a significant cataract and underwent phacoemulsification.

VISUAL RESULTS

The mean visual improvement in 23 eyes was 2.5 Snellen lines (range, 0 to 6 lines). As indicated in **Table 3**, 16 eyes (69.6%) had a visual improvement and 7 eyes (30.4%) remained stable after surgery. Ten eyes (43.5%) improved 3 or more lines and 4 eyes (17.4%) improved more than 4 lines. Eyes that underwent vitrectomy alone had a mean improvement of 1.8 lines (range, 0 to 5 lines), and the eyes that underwent phacovitrectomy had a mean improvement of 3.3 lines (range, 0 to 6 lines). The differences between preoperative and postoperative mean and median values were statistically significant ($P<.001$) in all groups (Table 3).

INTRAOPERATIVE FINDINGS

Although a Weiss ring was detected preoperatively in 14 eyes, during surgery all eyes had a thin, fenestrated membrane covering the posterior pole and adhering to the margins of the staphyloma. This membrane was sometimes multilayered and focally attached to the retina in 1 or more points inside the staphyloma. No histological analyses were carried out on the specimens. They were, however, judged in terms of posterior hyaloid remnants according to consistency and appearance and by the fact that they were seen well with triamcinolone acetate but did not stain with indocyanine green. Finally, we peeled the indocyanine green–stained ILM, which was often incomplete and easily breakable and sometimes focally elevated from the underlying retina.

Table 3. Changes in VA (logMAR)

	Total Group (23 Eyes*)	PPV (14 Eyes*)	PPV + Phaco (9 Eyes)
VA (logMAR)			
Preoperative mean†	0.6	0.6	0.6
Median†	0.7	0.7	0.7
Range	1.1 to 0.2	1.1 to 0.2	1.1 to 0.2
Postoperative mean†	0.43 ($P<.001$)	0.5 ($P=.003$)	0.38 ($P=.001$)
Median†	0.5 ($P<.001$)	0.5 ($P=.004$)	0.4 ($P=.008$)
Range	1.1 to −0.1	1.1 to −0.1	1 to −0.1
VA improvement, stable, No. (%)	7 (30.4)	5 (35.7)	2 (22.2)
1-2 lines	6 (26.1)	6 (42.9)	0
3-4 lines	6 (26.1)	2 (14.3)	4 (44)
>4 lines	4 (17.4)	1 (7.1)	3 (33.8)

Abbreviations: logMAR, logarithm of the minimum angle of resolution; phaco, phacovitrectomy; PPV, pars plana vitrectomy; VA, visual acuity.
*Aborted surgery not included (eye 8 in Table 1).
†The difference between preoperative and postoperative mean and median values was statistically significant using a paired *t* test and Wilcoxon signed rank test (data not reported).

COMMENT

This large retrospective case series of 24 highly myopic eyes with MTM demonstrates that vitrectomy with release of vitreoretinal traction leads to stable anatomical recovery and visual improvement and that this result can be achieved without the use of vitreal tamponade. Previously published smaller surgical case series[10,13,14] and case reports[15-17] have reported similar results but with the adjunct of gas tamponade and prone positioning. In this study, we obtained an equal or higher rate of anatomical resolution (95.8%) without flattening the retina with gas.

A preliminary observation of these positive surgical results relates to the term in the literature for this condition: *foveal retinoschisis*. The term *inner* or *outer retinal schisis* defines a complete separation between retinal layers, responsible for an irreversible and total loss of retinal function. On the contrary, all published case series of foveal retinoschisis report a good visual improvement. This retinal damage is consequently not a schisis but retinal swelling with fluid accumulation. This condition, in our opinion, would therefore be better described by another name. In this article, as well as in our previous article on this matter,[9] we propose the name MTM.

Of relevance is the high female prevalence of 87.5% in this series, not noted by other authors, but similar to all the other published series (79.6% of a total of 68 eyes). This prevalence is higher than the female prevalence of 56% to 60% reported in the literature for high myopia[9,20] and might be related to hormonal factors inherent to myopic vitreopathy.[21]

Regarding visual acuity (Table 1 and Table 3), the mean improvement in this series was 2.5 lines in the whole group, with a mean improvement of 1.8 lines in cases of vitrectomy and 3.3 lines in cases of combined phacovitrectomy, where surely the lens extraction played a role. Although a complete retinal flattening was achieved in all eyes, the wide range of visual change (0 to 6 lines) reflects the different grade of posterior chorioretinal atrophy ("M" column in Table 1) and probably other factors such as amblyopia or chronicity of retinal damage from MTM. The mean improvement in our group is in the same range of the other published case series (from 2 to 3.6 lines).

In all the eyes described in this series, the retina slowly flattened in a mean of 4.4 months. Others have similarly observed this slow process.[10,13,14] Even the associated retinal detachment in 5 eyes resolved over time. Four of them, however, along with 1 eye without associated retinal elevation, developed a full-thickness macular hole; none of these flat holes progressed to macular retinal detachment during follow-up.

As hypothesized by other authors[3,10,16] and also observed in 2 eyes,[7] our findings strongly suggest that macular detachment precedes hole formation in highly myopic eyes. Other authors hypothesize that this tangential traction could be compared with the traction responsible for the formation of an idiopathic macular hole, but with the difference of a very concave shape of a myopic eye. In the presence of this profile, tangential epiretinal traction could first affect the inner retinal layers leading to the picture known as foveoschisis, comparable with the small foveolar detachment known as an impending hole in nonmyopic eyes. Depending on the depth of the staphyloma and the strength of the traction, this condition might be followed by a detachment of all retinal layers (macular detachment) and, finally, by the formation of a full-thickness hole. The surgical resolution of traction during the first stages of this process would allow the retina to flatten again, but in advanced cases and/or deep staphyloma, a full-thickness macular hole might develop during the process. Once sealed, the hole without traction would remain stable over time. Further studies are needed to confirm this mechanism.

The excellent and stable anatomical results after surgical release of traction demonstrate that this is the main

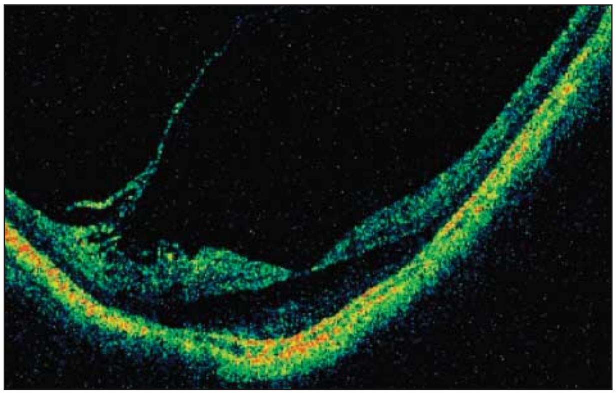

Figure 5. Vitreoretinal traction outside the macular area detected by a 10-mm optical coherence tomography scan. The focal area of vitreomacular traction in myopic traction maculopathy is usually located outside the fovea at the periphery of the staphyloma.

cause of MTM and that the presence of myopic staphyloma and retinal stretching are not sufficient to generate this anomaly.[7,22] We observed intraoperatively that this traction is generated by sheets of posterior vitreous cortex still adherent to the retina and bridging the borders of the staphyloma both in the presence of false PVD (large liquefied lacunae or posterior precortical vitreous pocket) or in cases of true PVD (hyaloid splitting). This membrane is often thick and light scattering and could be a further cause of visual impairment. Since the depth of the staphyloma determines the distance between the retinal surface and the membrane, this sheet of tissue is often invisible to OCT, detectable only in few cases with long scans (**Figure 5**).

As demonstrated by Kwok et al,[14] ILM peeling is probably not essential in these eyes but, in our opinion, remains an effective method for ascertaining the absence of any residual traction on the retinal surface. In our opinion, the border of ILM peeling with subsequent peripheral contraction produces the increase in arteriolar microfolds noticed by Ikuno et al,[13] Sayanagi et al,[12] and us.

Regarding the surgical indication for eyes with MTM, while major changes were found in patients complaining of recent visual loss, such improvement was also achieved in patients without reported visual symptoms. It seems reasonable, therefore, to consider surgery in all eyes where this condition involves the macular area and is judged to be damaging or jeopardizing visual function.

Submitted for Publication: May 15, 2006; final revision received October 28, 2006; accepted October 30, 2006.
Correspondence: Giacomo Panozzo, MD, Via del Perlar 2, 37135 Verona, Italy (g.panozzo@iol.it).
Financial Disclosure: None reported.
Acknowledgment: We thank Nicola Tommasi, Institute of Statistics, University of Verona, Italy, for the statistical analysis.

REFERENCES

1. Gonvers M, Machemer R. A new approach to treating retinal detachment with macular hole. *Am J Ophthalmol*. 1982;94:468-472.
2. Stirpe M, Michels RG. Retinal detachment in highly myopic eyes due to macular holes and epiretinal traction. *Retina*. 1990;10:113-114.
3. Takano M, Kishi S. Foveal retinoschisis and retinal detachment in severely myopic eyes with posterior staphyloma. *Am J Ophthalmol*. 1999;128:472-476.
4. Ishida S, Yamazaki K, Shinoda K, Kawashima S, Oguchi Y. Macular hole retinal detachment in highly myopic eyes. *Retina*. 2000;20:176-183.
5. Oshima Y, Ikuno Y, Motokura M, Nakae K, Tano Y. Complete epiretinal membrane separation in highly myopic eyes with retinal detachment resulting from a macular hole. *Am J Ophthalmol*. 1998;126:669-676.
6. Tano Y. Pathologic myopia: where are we now? *Am J Ophthalmol*. 2002;134:645-660.
7. Benhamou N, Massin P, Haouchine B, Erginay A, Gaudric A. Macular retinoschisis in highly myopic eyes. *Am J Ophthalmol*. 2002;133:794-800.
8. Baba T, Ohno-Matsui K, Futagami S, et al. Prevalence and characteristics of foveal retinal detachment without macular hole in high myopia. *Am J Ophthalmol*. 2003;135:338-342.
9. Panozzo G, Mercanti A. Optical coherence tomography findings in myopic traction maculopathy. *Arch Ophthalmol*. 2004;122:1455-1460.
10. Kobayashi H, Kishi S. Vitreous surgery for highly myopic eyes with foveal detachment and retinoschisis. *Ophthalmology*. 2003;110:1702-1707.
11. Ikuno Y, Gomi F, Tano Y. Potent retina arteriolar traction as a possible cause of myopic foveoschisis. *Am J Ophthalmol*. 2005;139:462-467.
12. Sayanagi K, Ikuno Y, Gomi F, Tano Y. Retinal vascular microfolds in highly myopic eyes. *Am J Ophthalmol*. 2005;139:658-663.
13. Ikuno Y, Sayanagi K, Ohji M, et al. Vitrectomy and internal limiting membrane peeling for myopic foveoschisis. *Am J Ophthalmol*. 2004;137:719-724.
14. Kwok AKH, Lai TYY, Yip WWK. Vitrectomy and gas tamponade without internal limiting membrane peeling for myopic foveoschisis. *Br J Ophthalmol*. 2005;89:1180-1183.
15. Kanda S, Uemura A, Sakamoto Y, Kita H. Vitrectomy with internal limiting membrane peeling for macular retinoschisis and retinal detachment without macular hole in highly myopic eyes. *Am J Ophthalmol*. 2003;136:177-180.
16. Kuhn F. Internal limiting membrane removal for macular detachment in highly myopic eyes. *Am J Ophthalmol*. 2003;135:547-549.
17. Ikuno Y, Tano Y. Early macular holes with retinoschisis in highly myopic eyes. *Am J Ophthalmol*. 2003;136:741-744.
18. Avila MP, Weiter J, Jalkh AE, Trempe CL, Pruett RC, Schepens CL. Natural history of choroidal neovascularization in degenerative myopia. *Ophthalmology*. 1984;91:1573-1581.
19. Chylack LT Jr, Wolfe JK, Singer DM, et al. The Lens Opacities Classification System III: the Longitudinal Study of Cataract Study Group. *Arch Ophthalmol*. 1993;111:831-836.
20. Fuchs A. Frequency of myopia gravis. *Am J Ophthalmol*. 1960;49:1418-1419.
21. Nguyen N, Sebag J. Myopic vitreoretinopathy: significance in anomalous PVD and vitreoretinal disorders. In: *Myopia and Related Diseases*. New York, NY: Ophthalmic Communications Society Inc; 2005:137-146.
22. Akiba J, Konno S, Yoshida A. Retinal detachment associated with a macular hole in severely myopic eyes. *Am J Ophthalmol*. 1999;128:654-655.