# The Myopic Retina: Taming the Beast

**WRITER** Dr. Abhishek Sharma and Dr. Christolyn Raj

Dr. Abhishek Sharma

Dr. Christolyn Raj

The risks of complications associated with myopia increase with age, making co-ordinated care of myopic patients essential to prevent loss of sight.

**"People live in** different sized houses, from small cottages to spacious mansions. But imagine if we all received the same amount of wallpaper to line the walls of our home. Those living in larger houses would need to stretch out their wallpaper, making it very thin to ensure it fits their walls. That wallpaper will be weaker, be prone to tearing, may not 'stick' to the wall as well and will have a tendency to curl over or tear in its weakest areas. As a myopic person, you could imagine your eye as a mansion, and the wallpaper as the retina."

As retinal specialists, we frequently use this explanation to begin the discussion about the many retinal issues a patient with myopia needs to be aware of and how we may manage their associated risks.

Generation X and Millennials are the group with the highest prevalence of myopia. Once suspected to be a 'looming epidemic', this ocular condition is now a real threat that exists only too commonly, particularly in many Asian countries.

Unfortunately, the retinal complications of myopia are the most vision threatening. Optometrists are in the perfect position to examine these patients, perform the necessary investigations and refer those 'at risk' in a timely manner to a retinal specialist.

This co-ordinated care is paramount to achieving successful outcomes in the management of myopia, particularly as this myopic generation ages and their risk of complications increases with age.

The main retinal issues that high myopes face as they age include:

- Macular pathology
- Peripheral retinal pathology
- Cataracts and refractive surgical considerations
- Glaucoma and the challenges in monitoring progression in a myopic eye

There is ongoing research into the mechanisms by which the above problems occur, including the link to increased axial lengths, choroidal and retinal thinning. We have yet to figure out how our treatment methods for myopia, such as orthokeratology or atropine, will affect the anatomy of the eye. In this article, we will briefly look at some of our knowledge on the myopic retina.

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## MYOPIC MACULOPATHY

Myopic maculopathy is becoming the leading cause of irreversible visual impairment in some Asian populations.[1,2] In the United Kingdom, it is the fourth commonest cause of severe visual impairment, ahead of diabetes![3] In Ireland and Israel it is already the third leading cause of blindness in the working age population.[4,5] Myopic macular changes include myopic foveoschisis; myopic macular holes, with or without localised retinal detachment; posterior staphyloma, and myopic macular degeneration. The extent of the pathology can often be difficult to assess due to the tessellated and atrophic myopic fundus, and regular ocular coherence tomography (OCT) hold the key to check for progression.

## MYOPIC FOVEOSCHISIS AND MACULAR HOLE

Foveoschisis involves a split in multiple retinal layers, often with a 'bridge' between the layers, giving a characteristic appearance on OCT. Often these patients notice distortion or loss of central vision, but many retain surprisingly good vision even if the macula looks horrendous on OCT. Over time though, their vision gradually deteriorates. A long-term study found that over a three-year period, approximately 66 per cent of these patients will have a significant decline in their vision, and 33 per cent will develop an associated macular hole.[6]

Figure 1

The image demonstrates a myopic foveoschisis in a thirty-five-year-old female, who still maintained visual acuity of 6/9! Through experience, most retinal surgeons avoid a membrane peel surgery on these patients unless there is a demonstrated decline in central vision. If this occurs, surgical intervention is strongly considered as the visual outcome is much more favourable at this stage before a macular hole develops. However, we make sure the patient understands that while it is possible to achieve excellent anatomical closure through surgery, the visual outcome will be affected by post-operative swelling. It may take months for swelling to resolve fully, and the re-apposition of the fragile underlying photoreceptors and Muller cell processes will ultimately dictate their final vision.

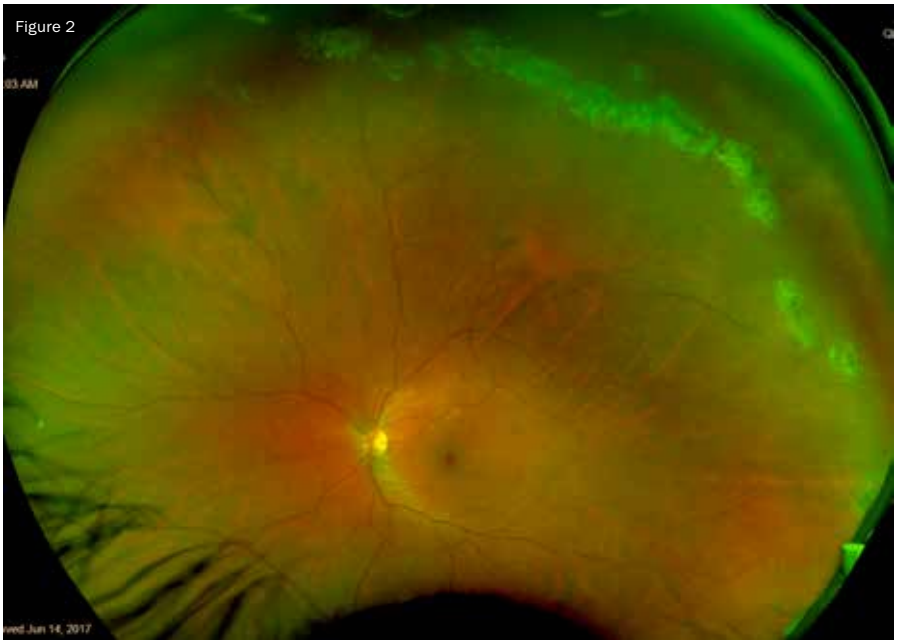
Macular holes can develop in conjunction with foveoschisis or separately. Once a hole has formed in a myopic fundus, there is an increased risk of progression to a macular-hole detachment, where vitreous fluid gradually creeps into the subretinal space at the site of macular hole. The poorly functioning retinal cells, the foveoschisis, and often the presence of a posterior staphyloma, all complicate the final visual outcome. These cases make for challenging surgeries, and again it's common for subretinal fluid to take months to resolve completely. Myopic macular holes without schisis have a high closure rate similar to non-myopic holes, approaching 90 per cent, however for those with significant schisis or macular hole detachment, the closure rate is approximately 50 per cent.[7,8] These statistics highlight the need for early referral of these patients if subtle changes suggesting a macular hole are noted clinically, or more likely on OCT imaging.

## MYOPIC MACULAR DEGENERATION

Myopic macular degeneration is a progressive disorder in pathologic myopia associated with chorioretinal atrophic changes and myopic choroidal neo-vascularisation membranes (CNVMs). We know high myopia has a familial link and thus far, several genes have been identified in the pathogenesis. However, their overall influence on the development of macular degeneration is unknown. Along with genetic factors, other factors include the long axial lengths and posterior staphylomas. These contribute to choroidal, Bruch's membrane (lacquer cracks) and RPE layer thinning, splitting and rupture. The significance of structural changes in the development of macular degeneration is still being studied. Age is a significant contributor to these biomechanical factors, for example, a posterior staphyloma is rarely seen in high myopes younger than age 40.[9]

Myopic CNVMs occurs in approximately 10 per cent of high myopes and 30 per cent of the patients who have CNVM in one eye will develop CNVM in their fellow eye.[10] This alarming incidence rate re-iterates the need for careful surveillance of myopic patients who have had a previous CNVM.

Figure 2



This is perhaps best done clinically with a high magnification lens to examine the macula for sub-retinal haemorrhage and regular follow-up with OCT imaging, looking particularly for subtle subretinal fluid. Should there be any doubt, even in the absence of macular pathology, an urgent referral to a retinal specialist should be considered. Such patients may often have foveoschisis and may require a fluorescein angiogram to ensure there is no active CNVM present.

**"Following recovery from retinal detachment surgery, a patient gets to know their optometrist well, as they make adjustments to maximise their vision"**

Untreated, these CNVMs gradually progress to scar formation, initially covered by retinal pigment epithelial (RPE) cells to form a dark pigmented spot (Fuchs spot) and then to chorioretinal atrophy resulting in permanent visual loss. While there is no treatment for chorioretinal atrophy, there is excellent treatment for CNVMs in the form of anti-vascular endothelial growth factor (anti-VEGF) injections, similar to age-related macular degeneration (AMD) patients. A recent five-year outcome study demonstrated that while the injections work at stopping active CNVMs, myopic CNVM patients require fewer injections than AMD patients. Similar to AMD patients, in managing patients with myopic CNVM, there needs to be sound collaboration between optometrists and the retinal specialist. These patients require frequent follow-up with OCT imaging in both eyes to monitor the treatment and detect new changes, with timely referral minimising delay in treatment.[11]

Patients receiving anti-VEGF injections for myopic CNVM should also be advised that they are at higher risk of developing a retinal detachment, and any symptoms of photopsia, floaters or changes in vision should be reported early.

## PERIPHERAL RETINAL CHANGES IN MYOPIA

If we use our wallpaper analogy we can appreciate that the peripheral retina in a myopic patient is susceptible to inherent weakness from peripheral stretching.

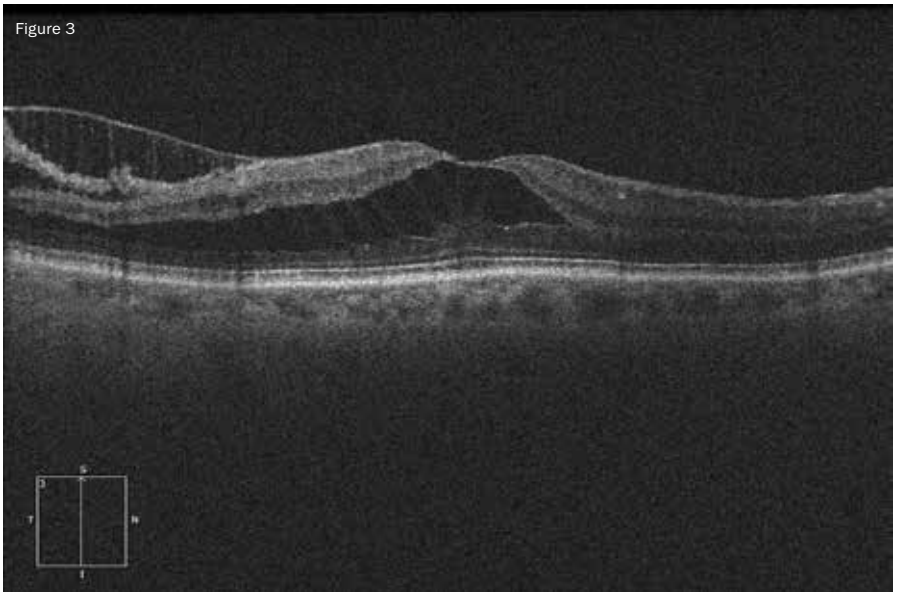


Figure 3

Peripheral retinal degeneration is not uncommon even in non-myopic eyes. These may include: lattice and snailtrack degeneration (figure 2); white without pressure (WWP); RPE pigmentary changes (Pavingstone, cobblestone); as well as retinal tears. A greater frequency of lattice retinal degeneration is found when the axial length is 25-27mm and 29-30mm, which corresponds respectively to myopia between 3-10 D. The relationship between the occurrence of peripheral chorioretinal changes also increases with axial myopia.

Myopia up to –3 D has been seen to increase the risk of retinal detachment, while myopia greater than –3 D increases the risk of retinal detachment tenfold. Given these figures, a diligent examination of the peripheral fundus in our myopic patients could avoid devastating complications of retinal detachment.

The presence of macular changes such as a foveal schisis or epiretinal membrane can signal potential peripheral degeneration such as the existence of a retinal break or other pathology that may be contributing to the macular pucker. There are many types of retinal breaks that may be found in the retinal periphery. The common ones include atrophic retinal holes with or without an operculum; atrophic single or multiple holes within an area of lattice; or a horseshoe or giant retinal tear. It may be reasonable to conservatively manage an atrophic hole or operculated hole in a non-myopic patient, but a myopic patient with increased risk of progression to retinal detachment may well benefit from prophylactic laser retinopexy.

Myopia also leads to earlier vitreous liquefaction, resulting in a posterior vitreous detachment (PVD). In various cohort studies, around 50 per cent of all patients with rhegmatogenous retinal detachment following a PVD were myopic. It is important to closely monitor any patient with symptoms and clinical signs of a PVD as the risk of a tear secondary to PVD is highest in the first few months following PVD. In those patients with an intact vitreous, cautious follow-up is still essential since the incidence of PVD in patients with high myopia increases with age.

The primary goal in treating peripheral retinal breaks in a myopic fundus is to prevent progression to retinal detachment requiring emergency surgery. Retinal detachment surgery in myopic patients can be quite challenging, because the vitreous is often still partially attached. Additionally, patients are younger in age and therefore phakic with the risk of developing a cataract post-operatively.

## RETINAL DETACHMENT

A retinal detachment in a high myope provides a few challenges. Often the patients tend to be younger, or have undergone recent intraocular surgery and have multiple retinal tears or areas of retinal thinning. Once their retina is detached in one area, it can progress quickly in other areas, including the inferior retina. With their extensive lattice, they can quickly form a Giant Retinal Tear, which involves a tear greater than three-clock-hours of the retina (figure 3).
A variety of factors decide the surgical steps, including the patient's age, presence of cataract, location of tears and detachment, other eye refraction and status. If the macula is involved, especially if there is a schisis, then there is greater likelihood of developing an associated macular hole detachment, which complicates the management further.

A vitrectomy is performed in the majority of cases, often supplemented with oil and/or scleral buckle, depending on

the detachment. In a high myope, a thinner and more elastic sclera provides a further challenge for buckling. From the detachment, but also due to the vitrectomy surgery and the use of a gas or oil tamponade, patients can develop early cataracts. This makes it important to we counsel our young detachment patients that they will lose accommodation following cataract surgery, and may need earlier surgery in their other eye due to anisometropic symptoms.

Following recovery from retinal detachment surgery, a patient gets to know their optometrist well, as they make adjustments to maximise their vision with their developing early cataracts, loss of accommodation, or anisometropia!

## CATARACT SURGERY IN MYOPIC PATIENTS

Performing cataract surgery in myopic patients can be extremely challenging. A step-wise approach to surgical co-management is therefore very important, in order to educate patients on why their surgical pathway may differ from non-myopic patients. It can also help us, as clinicians, to pre-empt potential complications and address risk factors before they have a chance to develop into true post-operative complications.

**What can we do to prepare our patients for cataract surgery?**

Myopic eyes have a higher risk of retinal complications, such as retinal detachment when compared with emmetropic eyes. Additionally, all of the pathologies discussed so far in this article may limit the postoperative vision achieved.

The most commonly discussed cataract surgery risk for highly myopic patients is retinal detachment. This makes a peripheral retinal examination mandatory for these patients. Peripheral retinal weakness can increase the risk of a postoperative retinal detachment. Some studies have shown that the risk of retinal detachment increases with increasing axial length. In one study, an axial length > 26.0mm was associated with a 0.9-3.8 per cent risk of retinal detachment while axial lengths of > 27.0mm and > 29.0mm were associated with risks of 0.5-6.5 per cent, and1.3-8.0 per cent.[12,13] Any retinal tears in the superior retina, or associated with lattice, may well benefit from prophylactic laser retinopexy pre-operatively.

All myopic eyes with any retinal breaks should be followed up after surgery with a dilated fundus examination. The other important pathology to look for is a posterior staphyloma, often associated with the optic disc. This can often complicate the measurement of the true axial length. Additionally, an eye with a staphyloma is at increased risk of globe perforation from peribulbar anaesthesia at the time of cataract surgery. Knowing this will allow the surgeon to consider alternative methods of measuring axial length as well as plan for an alternative, safer mode of anaesthesia administration at the time of surgery.

Myopic patients who have undergone cataract surgery tend to be among the most grateful. Not only do they have better vision after having had their cataract removed, they have also had their high myopia significantly reduced. However, it is important to always remember that while patients can be functionally emmetropic post-surgery, the myopic retinal changes remain. As a result, they will still require frequent follow-up at least on a four to six monthly basis for the first year following cataract surgery and yearly thereafter.

> "Our advice to patients – especially rural ones – who notice new vision symptoms, is to urgently visit their local optometrists rather than the emergency department or their GP"

## CONCLUSION

The retina is where the maximum damage from high myopia occurs. As vision specialists, we need to recognise the myopic patients at risk of retinal pathology, and warn them frequently about peripheral and central retinal symptoms. These patients can require more frequent follow-up, with a higher need for OCT scans and a greater chance of requiring urgent retinal treatment or surgery.

In patients with suspected myopic maculopathy, an OCT has become an essential tool, and serial OCTs over months or years are especially helpful. If there has been a decline in central vision in these patients, they should be referred onto a retinal specialist urgently within a week or earlier depending on findings. Similarly, in high-myope patients with peripheral retinal symptoms, a thorough fundus check should be done. If there is any concern or unusual features, they should be referred urgently for a full indented examination. A macula-on detachment has much better visual outcome than a macula-off detachment. For those being referred for cataract surgery, the fundus should be reviewed thoroughly and the patient should be counselled about the limitations that may remain due to their myopic maculopathy.

Our advice to patients – especially rural ones – who notice new vision symptoms, is to urgently visit their local optometrists rather than the emergency department or their GP. mi

Dr. Abhishek Sharma is a retinal specialist at Queensland Eye Institute in Brisbane. His specialties include retinal surgery for macular holes, epiretinal membranes and retinal detachments, as well as treatment for macular degeneration and severe diabetes. He is the author of Mindmaps in Ophthalmology published through CRC Press.

Dr. Christolyn Raj is a retinal specialist with Sunbury Eye Surgeons and Vision Eye Institute at Camberwell and Coburg, Victoria. SHe specializes in medical retina, cataract/refractive surgery and paediatric retinal eye disease. She is an Honorary Senior Lecturer at The University of Melbourne.

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