Taiwan Journal of Ophthalmology 4 (2014) 147–151

Contents lists available at ScienceDirect

Taiwan Journal of Ophthalmology

journal homepage: www.e-tjo.com

Review article

Current concepts and cutting-edge techniques in myopic macular surgeries

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ARTICLE INFO

Article history:
Received 3 March 2014
Accepted 21 March 2014
Available online 11 May 2014

Keywords:
macular hole
myopia
myopic foveoschisis
retinal detachment
vitrectomy

ABSTRACT

Myopic foveoschisis and macular hole with a retinal detachment are two major diseases associated with posterior staphyloma that are specific to high myopia. The pathogenesis is a combination of various types of traction from the vitreous cortex, epiretinal membrane (ERM), internal limiting membrane (ILM), and microvessels. Foveoschisis typically starts with retinoschisis, and a retinal detachment subsequently develops as a result of traction on the inner retina. The stress on the fovea eventually opens a small hole and leads to retinal detachment from a macular hole; thus, both are closely related. These two pathologies can be treated with vitrectomy. A foveal detachment is the best indication for surgery because of the greatest visual improvement. The routine surgical procedures are vitreous cortex removal with triamcinolone acetonide, ERM peeling, ILM peeling stained with Brilliant Blue G, and gas tamponade. The necessity for ILM peeling and gas tamponade for myopic foveoschisis remains controversial. A postoperative macular hole is a severe complication in foveoschisis, and a photoreceptor inner/outer segment defect seen on optical coherence tomography images obtained preoperatively is a risk factor for macular hole. A foveal nonpeeling can be considered to avoid foveal trauma. The inverted ILM peeling technique is a new option to enhance macular hole closure. Both techniques seem to enhance retinal restoration; however, the visual benefit has not been confirmed. A long-shaft forceps facilitates precise maneuvers. Vitrectomy for highly myopic macular diseases remains challenging; however, an understanding of the pathogeneses and innovations in vitreous surgical instruments and techniques will facilitate safer surgeries.

1. Introduction

Myopic foveoschisis is very common in patients with high myopia and occurs predominantly in middle-aged to older women. Myopic foveoschisis develops prior to a macular hole with retinal detachment, and both are major macular diseases that require vitrectomy. However, the surgery itself remains challenging due to atrophic and thin retinas, multiple and fragile membranes adhering to the retina, and the location of the retinal fundus far from the entry site. This article discusses the background information including clinical manifestations and pathogenesis, and the cutting-edge techniques in surgical procedures.

2. Pathogenesis

Myopic foveoschisis is characterized by retinoschisis and subsequent retinal detachment specific to highly myopic eyes. Posterior staphyloma is a risk and has a higher prevalence than in eyes without staphyloma.[1] Myopic foveoschisis was first described in the 1950s,[2] and was reported to commonly occur in 10 of 32 highly myopic eyes.[3]

However, it is difficult to diagnose myopic foveoschisis correctly without optical coherence tomography (OCT), which enables visualization of the microarchitecture and provides information to facilitate an understanding of the pathophysiology in high-myopic cases. Myopic foveoschisis is substantially a tractional disease that is generated from various components. The vitreous cortex is one cause of the inward traction on the retina. Vitreous adhesion to the retina and vitreoschisis are seen frequently during vitrectomy. Epiretinal membranes (ERMs) are common and also generate traction. The rigidity of internal limiting membranes (ILMs) and the retinal vascular traction are unique and both are newly found

Conflicts of interest: The author declares no conflicts of interest.

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http://dx.doi.org/10.1016/j.tjo.2014.03.006

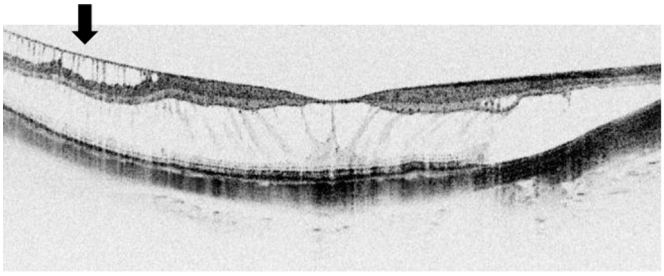

Fig. 1. Typical appearance of an internal limiting membrane (ILM) detachment (arrow), which is thought to result from the rigidity of this membrane. The ILM is separated, and some residual tissues form a bridge to the other retinal layers. This is most predominantly observed at the edge of the posterior staphyloma in a vertical section.

pathogenesis. Detachment of the ILM from the other retinal layer is often observed on OCT images[4] (Fig. 1). This indicates that the ILM is less flexible than the other retinal layers and exerts inward traction on those layers. Retinal vascular traction is postulated based on a unique OCT finding, the so-called retinal microfolds.[5,6] Retinal microfolds appear on OCT images as small peaks in the inner retina and are a typical finding after vitrectomy performed to treat myopic foveoschisis (Fig. 2). The retinal vessels, especially the retinal arterioles, are less flexible and cannot be stretched as much as the other retinal components. Thus, myopic foveoschisis is caused by multiple factors and can be regarded as a split between the flexible outer retina and the inflexible inner retina.

Macular holes often lead to retinal detachments in highly myopic eyes. Histologic studies of specimens obtained during vitrectomy have shown that the retinal detachment results from the tangential traction of the vitreous cortex and/or thin ERMs adhering to the retinal surface.[7,8] OCT has demonstrated a more detailed mechanism related to myopic foveoschisis. Myopic foveoschisis starts with retinoschisis but ultimately leads to a macular hole through a focal retinal detachment.[9] Two types of macular holes develop in high myopia, one of which is flat without retinoschisis and the other is the retinoschisis type.[10] The latter exerts powerful traction and is highly likely to progress to a retinal detachment. It is often rapidly progressive and can progress in only 1–2 weeks to widespread detachment from formation of a hole. The flat type does not exert traction, is typically stable, and has a higher anatomic postoperative success rate compared with the retinoschisis type.

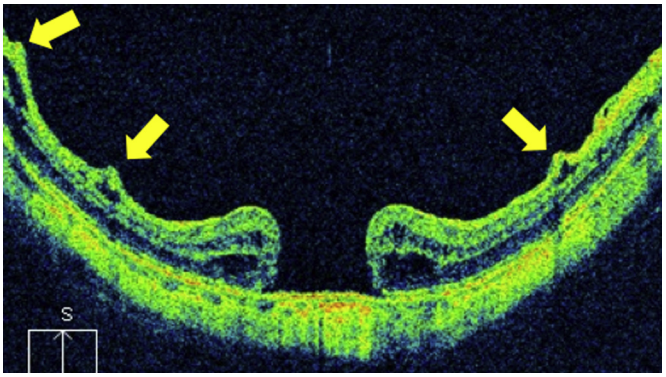

Fig. 2. Typical appearance of retinal microfolds (arrows), which are mostly recognizable only on optical coherence tomography (OCT) images. The microfolds appear as sharp peaks and are located along with retinal vessels, especially arterioles. Microfolds have acoustic shadows on the OCT images, suggesting the coincidence with retinal vessels. There is a higher chance of finding microfolds in vertical sections because the retinal vessels mostly run horizontally.

3. Clinical manifestations and diagnosis

OCT shows a variety of appearances of myopic foveoschisis including lamellar holes and retinal cysts.[11] Myopic foveoschisis begins as retinoschisis without a retinal detachment (i.e., the retinoschisis type). A retinal detachment can start at the fovea after several months or years if there is sufficient traction (i.e., the foveal detachment type; Fig. 3).[9]

The natural course of myopic foveoschisis is poor,[12,13] and 11–50% of patients have a retinal detachment and/or macular hole formation within 2–3 years of follow-up without treatment. The high risk of severe visual loss from macular holes with retinal detachments is a motivation for surgery.

A macular hole with a retinal detachment has a wide range in the area. Some patients are stable and the pathology is localized within the posterior staphyloma for months; however, most proceed to the development of an extensive detachment beyond the edge of the staphyloma. A small hole is seen in the central macular area on ophthalmoscopy and can be confirmed by the OCT, which generally shows a detached retina and a hole with or without surrounding retinoschisis.

4. Treatment

4.1. Surgical goals and indications

Vitrectomy is the most common treatment for myopic foveoschisis.[14–18] The surgical goal is to release all retinal traction to reattach and reconstruct the normal structure. As mentioned previously, there are several subtypes; however, the subtypes with the

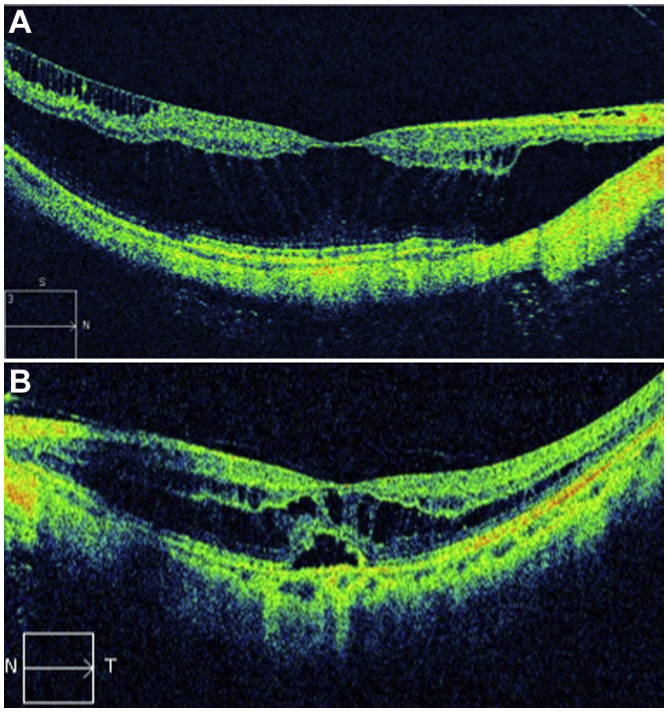

Fig. 3. Two types of myopic foveoschisis are seen on optical coherence tomography images. (A) The retinoschisis type is characterized by only retinoschisis and no retinal detachment has started, whereas (B) the foveal detachment type is more advanced, and the photoreceptors are separated from the pigment epithelium.