Case Report

Initial Experience of Macular Translocation in Singapore – One-year Results

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Abstract

Introduction: This paper reports the 1-year results of the first 2 cases of macular translocation in Singapore. Clinical Picture: A 66-year-old female and a 45-year-old male Chinese presented with subfoveal choroidal neovascularisation (CNV) in their right eyes. The woman's condition was secondary to pathological myopia while the man's was idiopathic. Their preoperative best-corrected visual acuities were 6/15-2 and 6/30, respectively. Treatment: Both patients underwent macular translocation with punctate retinotomies and chorioscleral infolding (limited macular translocation) in their affected eye. Outcome: Both patients achieved effective macular translocation postoperatively. Their CNVs became extrafoveal and were ablated with conventional laser photocoagulation in the early postoperative period. They did not recur and their visual acuities improved to 6/9-1 and 6/12 at 1 year postoperatively, respectively. Conclusion: Macular translocation is a new treatment modality that offers patients with subfoveal CNV a chance of improving their vision, potentially to a level that may allow reading and driving.

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Key words: Choroidal neovascularisation, Macular degeneration, Myopia, Ophthalmologic surgical procedure, Vitrectomy

Introduction

Choroidal neovascularisation (CNV) is a devastating complication of macular degeneration and a major cause of irreversible vision loss in many developed countries. The most common cause of CNV is age-related macular degeneration but it may also occur secondary to a variety of other aetiologies such as pathological myopia, ocular histoplasmosis syndrome and angioid streaks.[1-4]

The treatment options currently available for CNV are limited. Only 2 modalities, namely laser photocoagulation[5-7] and photodynamic therapy with verteporfin (Visudyne, CIBA Vision Corp, Duluth, Ga),[8-10] have been shown in large randomised clinical trials to be beneficial to selected cases of CNV. Unfortunately, the majority of CNV is not treatable by laser photocoagulation because the lesions are often subfoveal or too large. In addition, because laser photocoagulation of subfoveal CNV is associated with an immediate decrease of 3 Bailey-Lovie lines, few ophthalmologists perform the treatment.[11] Although certain subfoveal CNVs can be treated with photodynamic therapy, significant improvement of visual acuity with this modality of treatment is unusual.[8-10]

Macular translocation is a novel treatment strategy that has recently emerged for the management of subfoveal CNV.[12-17] It is defined as any surgery that has the primary goal of relocating the central neurosensory retina or fovea intraoperatively or postoperatively specifically for the management of macular disease.[18]

The surgical objective of macular translocation is to reposition the neurosensory retina of the fovea in an eye with subfoveal CNV to a new location with a presumably healthier bed of retinal pigment epithelium-Bruch's membrane-choriocapillaris complex devoid of the lesion. The rationale is that the displacement re-establishes a more normal subretinal space beneath the fovea and allows the fovea to recover or maintain its visual function. In addition, relocating the fovea overlying the CNV to an area outside the border of the CNV "converts" the subfoveal lesion to

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one that is juxta- or extra-foveal. This allows the destruction of the CNV with conventional thermal laser photocoagulation without destroying the fovea, thereby preserving central vision and arresting the progression of the CNV. When combined with submacular surgery, macular translocation allows the fovea to be relocated to an area outside the retinal pigment epithelial defect often associated with CNV removal.[12,15,18,19]

There are several techniques of macular translocation currently in use, reflecting the different surgical strategies used to displace the macula.[18] According to an international classification proposed by Au Eong and associates, these different techniques may be classified according to the size of the retinotomy/retinotomies used as follows:[18]

1) macular translocation with punctate or no retinotomy/retinotomies (also known as limited macular translocation).[20,21]
   This group may be further subdivided into those performed
   a) with chorioscleral shortening[22,23] or
   b) without chorioscleral shortening.[24]
      Chorioscleral shortening may be effected by chorioscleral infolding (imbrication or inpouching)[12,15,16,22,23] or chorioscleral outfolding (outpouching).[25,26]
2) macular translocation with large curvilinear "incisions" of the retina.
   This group may be further subdivided into
   a) macular translocation with 360° circumferential retinotomy[27-30] and
   b) macular translocation with large but less than 360° circumferential retinotomy.[31,32]

This paper reports the 1-year results of the first 2 cases of macular translocation in Singapore, using the technique with punctate retinotomies and chorioscleral infolding.

Case Reports

Case 1

A 66-year-old Chinese woman complained of a "dark patch" in the central visual field of her right eye for several weeks. She had a history of bilateral phacoemulsification and intraocular lens implantation and was known to have bilateral pathological myopia of –12 dioptres prior to her cataract surgeries. Her best-corrected visual acuity was 6/15-2 with a refraction of –2.00 DS/-1.75 DC x 50 in the right eye and 6/30-2 with a refraction of +0.50 DS/-3.25 DC x 100 in her left eye. Clinical examination (Fig. 1) and fluorescein angiography (Figs. 2 and 3) disclosed bilateral myopic macular degeneration and a small subfoveal CNV with secondary retinal pigment epithelial hypertrophy in her right eye.

After considering the potential risks and benefits of macular translocation and other management options including observation, the patient gave written informed consent for limited macular translocation and underwent the procedure on 4 October 2001 without complications.

The details of the technique used for macular translocation, reported elsewhere,[12-14] are briefly described here.[15] A superotemporal conjunctival peritomy from 7 to 2 o'clock position was made and the superior and lateral recti were isolated. Three nonabsorbable 5/0 Ethibond imbricating sutures were placed in the superotemporal quadrant between the superior and lateral recti, 1 suture just nasal to the superior rectus in the superonasal quadrant and 1 suture just inferior to the lateral rectus in the inferotemporal quadrant. The sutures were placed in a mattress fashion 6 mm apart from anterior to posterior extent and straddling the equator. They were not tightened until later on in the procedure.

Three sclerostomies were made 3 mm from the corneal limbus and the superonasal and superotemporal sclerostomies were fitted with metal cannulas (Grieshaber & Co. AG, Schaffhausen, Switzerland) to protect the entry sites, reduce vitreous base traction, and allow easy exchange of 20-gauge (0.9 mm diameter) intraocular instruments, particularly the delicate 41-gauge retinal hydrodissection cannula (MADLAB retinal hydrodissection cannula, Bausch & Lomb Surgical, St Louis, MO).[33-35] A standard three-port near-total pars plana vitrectomy was performed and the vitreous base was trimmed. Three localised retinal detachments were created by injecting balanced salt solution subretinally using a 41-gauge retinal hydrodissection cannula through 3 small retinotomies placed superior to the superotemporal vascular arcade, inferior to the inferotemporal vascular arcade and temporal to the macula. A complete fluid-air exchange was then performed and this caused the subretinal fluid to gravitate posteriorly and dissected the macula off the underlying retinal pigment epithelium. The air in the vitreous cavity was then exchanged for fluid and the retina was gently manipulated with a retinal manipulator (Bausch & Lomb Surgical, St Louis, MO) to ensure that the macula was completely detached. The imbricating sutures were then tightened while the eye was left soft.

Fluid-air exchange was then repeated and an estimated 90% exchange was performed. The sclerostomies and conjunctival peritomy were then closed with 7/0 Vicryl sutures. Subconjunctival injections of dexamethasone, gentamicin and cephazolin were given. After the eye was patched, the patient was turned onto her side that was operated on, for 5 minutes, to allow the subretinal fluid to gravitate temporally to detach the temporal peripheral retina. From this position, without turning the patient on

her back, the patient was sat upright and instructed to keep her head upright for several days.

On the first postoperative day, the visual acuity was hand movement and there was a 60% air bubble in the vitreous cavity. The superior retina was attached but the inferior retina was detached. The chorioscleral infolding was visible on ophthalmoscopy in the superotemporal quatrant. The air bubble was gradually absorbed (Fig. 4) such that by the fourth postoperative day, the air bubble was about 40% in size, the retina was completely reattached and the macula was clearly visualised (Fig. 5). Fluorescein angiography performed disclosed that the neurosensory retina had moved inferiorly relative to the underlying tissues and the CNV (Fig. 6). The subfoveal CNV had become extrafoveal, and conventional laser photocoagulation was applied to the CNV to ablate the lesion (Fig. 7).

Her visual acuity improved to 6/12-2 by 6 weeks postoperatively and 6/12 with a refraction of plano/-4.00 DC x 60 by 3 months postoperatively (Figs. 8 and 9). Close follow-up and monitoring disclosed no recurrence of the CNV and the visual acuity was 6/9-1 at 1 year after the operation. The patient did not experience any diplopia or incyclotropia during the postoperative period.

Case 2

A 45-year-old Chinese man with a history of –2 dioptres myopia bilaterally and dilated cardiomyopathy presented with metamorphopsia in the right eye for 1 week. His best-corrected visual acuity was 6/9 in the right eye and 6/6 in the left eye. Ophthalmic examination (Fig. 10) and fluorescein angiography (Fig. 11) disclosed a small idiopathic juxtafoveal CNV superotemporal to the foveal centre in the right eye. The patient underwent laser photocoagulation of the lesion (Fig. 12). Three weeks after the laser photocoagulation, he complained of worsening metamorphopsia and an enlarging relative scotoma in the right eye. His visual acuity had decreased to 6/30 with a refraction of –2.00 DS/-1.00 DC x 60. Clinical examination (Fig. 13) and fluorescein angiography (Fig. 14) showed a persistent CNV that had extended under the geometric centre of the foveal avascular zone.

After considering all potential management options including no treatment, the patient gave written consent and underwent limited macular translocation with the same technique as in case 1 on 8 November 2001.

On the first postoperative day, the visual acuity was counting fingers 2 feet with a 60% air bubble in the vitreous cavity. The macula was obscured by the air bubble when the patient was upright. The superior retina was reattached but the inferior retina was still detached. By the fifth postoperative day, the retina was completely reattached and fluorescein angiography disclosed that the macula had moved inferiorly relative to the underlying choroidal tissues (Figs. 15, 16 and 17). The CNV had become extrafoveal after the operation. A tiny eccentric hole was also noted inferior to the foveal centre. Laser photocoagulation was applied to the CNV successfully, sparing the foveal centre (Fig. 18).

His best-corrected visual acuity improved to 6/12 by 3 weeks and 6/9-2 by 5 months after the operation with a refraction of plano/-1.50 DC x 75 (Figs. 19, 20 and 21). There was no recurrence of the CNV and the visual acuity was 6/12 at 1 year after the operation. The patient noticed incyclotropia and diplopia after the operation but his symptoms in the primary gaze decreased gradually and disappeared 5 months after the operation. His metamorphopsia improved but he had residual mild micropsia and binocular diplopia on extreme gaze.

Discussion

To the best of my knowledge, these 2 cases of macular translocation described are the first in Singapore. Both cases had subfoveal CNV that were likely to lead ultimately to impaired central vision or central blindness without treatment. Two other Asian countries, Japan[31,36-42] and Taiwan,[43] have reported on this novel surgical technique.

At first glance, it may appear reasonable to extrapolate results of the Macular Photocoagulation Study for subfoveal CNV to treat the 2 cases described. The Macular Photocoagulation Study proved that laser photocoagulation of the entire area of subfoveal CNV secondary to age-related macular degeneration is beneficial with regard to long-term visual acuity when compared to no treatment.[7,44,45] However, the treatment causes an immediate average reduction of 3 Bailey-Lovie lines in visual acuity because of collateral damage to overlying neurosensory retina. In addition, the benefits of laser photocoagulation over no treatment only become apparent 6 months later and retention or recovery of good vision rarely occurs in treated patients. Eyes with subfoveal new CNV treated with laser photocoagulation achieved an average visual acuity of 6/96 compared with 6/120 in untreated eyes after 24 months of follow-up. None of the 77 eyes in the subfoveal new CNV study had visual acuity 6/24 or better, while 88% had visual acuity 6/60 or worse at the 48-month examination following laser photocoagulation. For these reasons, it is not surprising that a recent survey of all consultant ophthalmologists in the United Kingdom and the Republic of Ireland found that only 13.6% of 339 ophthalmologists whose practice included laser photocoagulation of CNV secondary to age-related macular degeneration stated that they ablate subfoveal CNV with laser photocoagulation.[11] The main reason (73.6%) the ophthalmologists gave for withholding treatment was that they were not prepared to

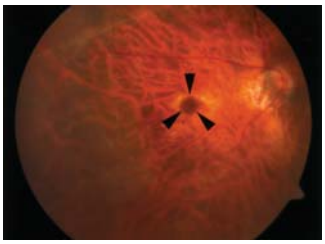

Fig. 1.

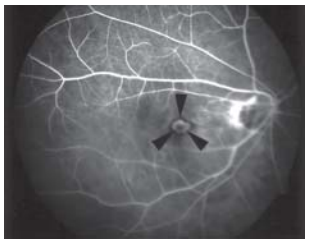

Fig. 2.

Fig. 1. Preoperative colour fundus photograph shows a small subfoveal choroidal neovascularisation (CNV) with secondary retinal pigment epithelial hypertrophy due to pathological myopia (arrowheads) in the right eye. Visual acuity is 6/15-2.

Fig. 2. Fluorescein angiogram of the same eye as in Figure 1 shows a well-circumscribed subfoveal CNV (arrowheads) in the arteriovenous phase.

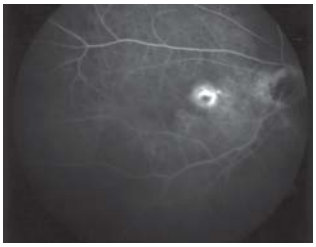

Fig. 3.

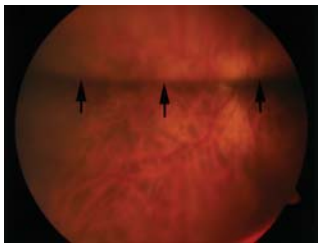

Fig. 4.

Fig. 3. Late phase fluorescein angiogram of the same eye as in Figures 1 and 2 shows profuse leakage from the subfoveal CNV.

Fig. 4. Postoperative colour fundus photograph of the same eye as in Figure 1 two days after limited macular translocation shows a large air bubble obscuring the optic disc and fovea. The fluid-air interface is indicated by the arrows.

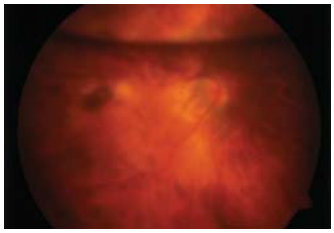

Fig. 5.

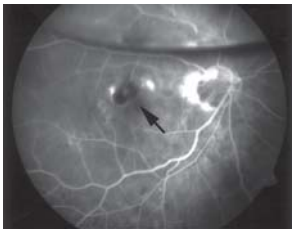

Fig. 6.

Fig. 5. Postoperative colour fundus photograph of same eye as in Figure 1 four days after limited macular translocation shows a 40% air bubble. The air bubble no longer obscures the view of the optic disc and fovea.

Fig. 6. Postoperative fluorescein angiogram of the same eye as in Figure 5 shows that foveal centre (arrow) has been displaced inferonasally relative to the CNV after limited macular translocation.

accept the likelihood of an immediate drop in visual acuity following laser ablation. Currently, the use of laser photocoagulation for subfoveal CNV has been superceded in many centres by photodynamic therapy although it remains the treatment of choice for extrafoveal and most juxtafoveal CNV.

Photodynamic therapy with verteporfin has recently been shown to provide some modest benefits for selected subfoveal CNVs in retarding vision loss but multiple re-

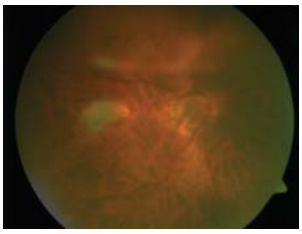

Fig. 7.

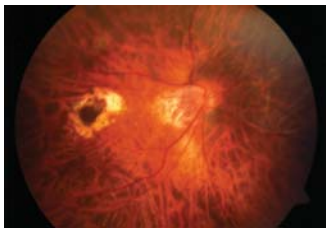

Fig. 8.

Fig. 7. Colour fundus photograph of the same eye as in Figure 5 shows confluent white laser burns applied to the extrafoveal CNV after the macular translocation. The photograph is yellowish in colour because of the presence of fluorescein in the vitreous cavity after fluorescein angiography.

Fig. 8. Postoperative colour fundus photograph 3 months after surgery shows a laser scar over the previous CNV superotemporal to the foveal centre. Visual acuity is 6/12.

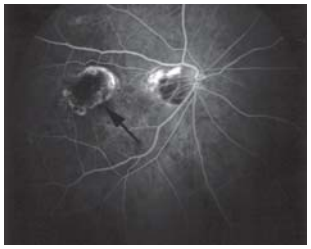

Fig. 9.

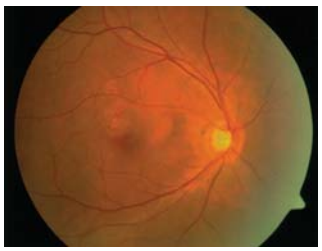

Fig. 10.

Fig. 9. Postoperative fluorescein angiogram 3 months after surgery shows staining of the laser scar and no recurrence of CNV. The foveal centre (arrow) is preserved.

Fig. 10. Colour fundus photograph of the right eye at presentation shows a CNV superotemporal to the foveal centre. Visual acuity is 6/9.

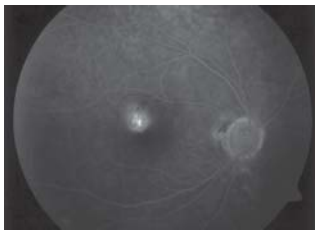

Fig. 11.

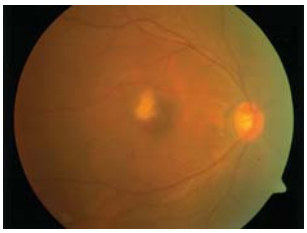

Fig. 12.

Fig. 11. Late phase fluorescein angiogram of the same eye as in Figure 10 shows profuse leakage from the juxtafoveal CNV.

Fig. 12. Colour fundus photograph of the same eye as in Figure 10 shows white confluent laser burns applied to the CNV.

treatments are usually necessary.[8-10] A major advantage of macular translocation over photodynamic therapy is the realistic hope that a single surgical procedure may reduce the need for multiple costly re-treatments for recurrent CNV. In addition, improvement in vision following photodynamic therapy is uncommon.[8-10] Only 9% of eyes treated with photodynamic therapy compared with 3.9% of eyes given placebo had an increase of 3 or more lines of visual acuity at 2 years in a major randomised clinical trial.[9] Hence, although the complications associated with photodynamic therapy are relatively few and minor, the potential for significant visual improvement is also low.

Fig. 13.

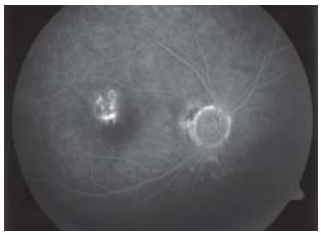

Fig. 14.

Fig. 13. Colour fundus photograph of the same eye as in Figure 10, 3 weeks after laser photocoagulation shows persistent CNV. Visual acuity is 6/30.

Fig. 14. Fluorescein angiogram of the same eye as in Figure 13 (3 weeks after laser photocoagulation) shows persistence of the CNV that has now become subfoveal.

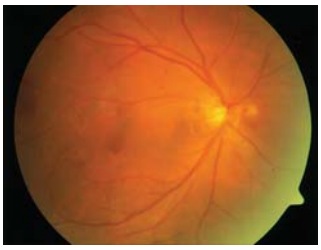

Fig. 15.

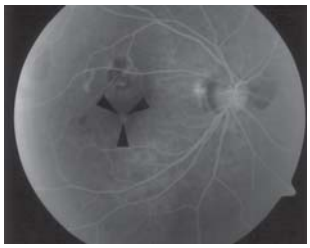

Fig. 16.

Fig. 15. Postoperative colour fundus photograph of the same eye as in Figure 13, 5 days after limited macular translocation. A small hole has developed just inferior to the foveal centre.

Fig. 16. Postoperative fluorescein angiogram of the same eye as in Figure 15 (5 days after limited macular translocation) shows a hyperfluorescent retinal pigment epithelial "window defect" corresponding to the eccentric macular hole (arrowheads). The CNV is now in an extrafoveal location superior to the foveal centre.

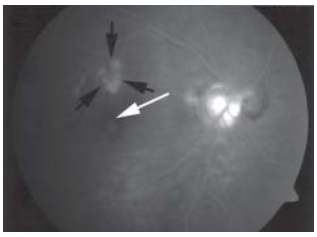

Fig. 17.

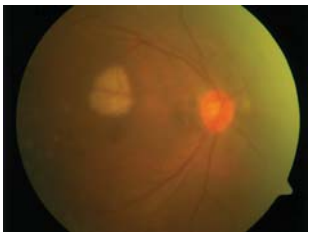

Fig. 18.

Fig. 17. Postoperative late phase fluorescein angiogram of the same eye as in Figures 15 and 16 show leakage of the CNV (black arrows) which is now located in an extrafoveal position superior to the foveal centre (white arrow).

Fig. 18. Postoperative colour fundus photograph of the same eye as in Figure 15 shows white confluent laser burns applied to the extrafoveal CNV.

Surgical removal of subfoveal CNV may be a possible treatment option for these 2 cases but this may be complicated by inadvertent loss of retinal pigment epithelium, thereby limiting visual improvement.[46,47] Interestingly, this complication of submacular surgery may be managed by macular translocation, which can displace the fovea to an area outside the retinal pigment epithelial defect.[48] The benefits, if any, of submacular surgery for selected cases of CNV are currently being evaluated in the Submacular Surgery Trials sponsored by the National Eye Institute (National Institutes of Health, Bethesda, MD).

Fig. 19.

Fig. 20.

Fig. 19. Postoperative colour fundus photograph 6 weeks after limited macular translocation shows a laser scar superior to the foveal centre. Visual acuity is 6/12.

Fig. 20. Early arteriovenous phase fluorescein angiogram of the same eye as in Figure 19, 6 weeks after limited macular translocation shows a hyperfluorescent retinal pigment epithelial defect corresponding to the eccentric macular hole.

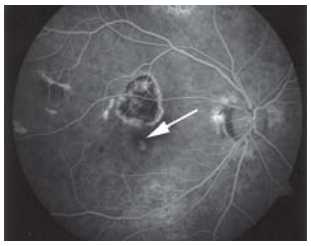

Fig. 21. Late phase fluorescein angiogram of the same eye as in Figures 19 and 20, 6 weeks after limited macular translocation shows staining of the laser scar superior to the foveal centre (white arrow) with no recurrence of CNV.

Other alternative therapies for the treatment of subfoveal CNV such as interferon alpha-2a,[49-52] radiation,[53,54] and subretinal endolaser photocoagulation[55] have been found to be of little or no benefit.

In the 2 patients described above, limited macular translocation was a reasonable option because the minimum desired translocation in both cases was small. For inferior macular translocation, the minimum desired translocation is defined as the distance between the foveal centre and a point on the inferior border of the subfoveal lesion such that these points are equidistant from the temporal edge of the optic disc.[18] When the minimum desired translocation is small, the postoperative foveal displacement need not be excessively large to result in effective macular translocation.[12,18] In a consecutive series of 102 cases of limited macular translocation reported by Pieramici and associates, the median postoperative foveal displacement achieved was 1200 μm (range, 200 to 2800 μm).[22] Seventy-five per cent of the cases experienced at least 900 μm of postoperative foveal displacement and 25% achieved 1500 μm or more of foveal displacement. By carefully selecting these 2 cases with small minimum desired translocation, it was not surprising that effective macular translocation was achieved in both. This in effect caused

the CNV to become extrafoveal, allowing the fovea to maintain its function over a presumably healthier bed of retinal pigment epithelium-Bruch's membrane-choriocapillaris complex. After the fovea was relocated to an area outside the border of the CNV, ablation of the CNV by laser photocoagulation was carried out without destroying the fovea, thereby arresting the progression of the CNV and preserving central vision.

The greatest benefit of macular translocation is the potential for improvement in visual acuity postoperatively. These 2 cases as well as other reports on macular translocation are encouraging, and suggest that significant improvement in visual acuity can be achieved in some cases. In Pieramici and associates' series, at 3 and 6 months postoperatively, 31% and 49% of the eyes respectively achieved a visual acuity better than 6/30 while 37% and 48% of the eyes respectively experienced 2 or more Snellen lines of visual improvement.[22] Sixteen per cent of the eyes experienced 6 or more Snellen lines of visual improvement. By 12 months postoperatively, 38.2% of the eyes achieved a visual acuity of 6/30 or better, 44% of the eyes experienced 1 or more Snellen lines of visual improvement from their preoperative measurement, 17% had unchanged visual acuity, and 39% lost 1 or more lines of visual acuity.

The 3 most important factors for good visual outcome following limited macular translocation are (i) proper patient selection, (ii) achieving the desired amount of macular translocation, and (iii) avoidance of complications. If this procedure is performed on a patient without viable foveal photoreceptors, there is virtually no chance for visual improvement. If the minimum desired translocation is not achieved, persistence of the CNV in the subfoveal location will likely result in continued photoreceptor cell damage and visual deterioration. Development of a complication is associated with a poorer visual prognosis, particularly when retinal detachment occurs.

Proper case selection, by identifying patients with good photoreceptor function for surgery and excluding others with irreversible photoreceptor damage from the procedure, is of critical importance to achieving good visual outcomes. The foveal function can be assessed preoperatively by a number of means including measurement of visual acuity, scanning laser ophthalmoscope microperimetry, and focal electroretinography. An analysis of a large series has shown that preoperative visual acuity is a significant predictor of postoperative visual outcome, with good preoperative visual acuity being associated with better postoperative visual results.[22] Since visual acuity is a functional test of the macular neurosensory cells, good preoperative vision probably reflects commensurate retinal cell function. Poor visual acuity, however, does not necessarily reflect permanent photoreceptor damage since a number of factors such as subretinal haemorrhage and fluid can cause visual impairment. In fact, eyes with poor preoperative visual acuity (≤6/96) experienced the largest amount of visual improvement after the procedure in Pieramici and associates' series.[22]

Macular hole is a relatively frequent complication of limited macular translocation and occurred in 12 out of 153 eyes in 1 series.[56] It probably occurs during the detachment of the macula, especially in eyes where the macula is more adherent to the underlying choroidal neovascular complex. A small macular hole eccentric to the foveal centre developed in case 2 but fortunately did not cause severe impairment of vision.

Conclusion

Macular translocation is a new treatment modality that offers patients a chance of improving their vision, potentially to a level that may allow reading and driving.[57] Proper patient selection avoids surgery in eyes with permanently damaged central retina and identifies eyes with the greatest potential for good visual outcomes. Functionally, patients with recent-onset subfoveal CNV without permanent foveal neurosensory retina damage have the greatest likelihood of good visual outcome. Anatomically, the best candidates have small minimum desired translocations and relatively healthy retinal pigment epithelium-Bruch's membrane-choriocapillaris complex beyond the borders of the lesion.

The exact role of limited macular translocation for the management of subfoveal CNV in the current era of photodynamic therapy has yet to be fully evaluated. A pilot multicentre randomised clinical trial is currently underway in the United States to compare the efficacy of limited macular translocation with photodynamic therapy in eyes with subfoveal CNV secondary to age-related macular degeneration.

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