Visual function and patient satisfaction after macular hole surgery

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CLINICAL STUDY

Abstract

Purpose **Over recent years success in macular hole surgery has increased in terms of anatomical closure. However, debate still continues on the benefit to the patient in terms of visual outcome. We designed a prospective study to investigate the outcome of full thickness macular hole (FTMH) surgery in terms of anatomical closure, visual outcome, incidence of complications and patient satisfaction.**

Methods **Thirty eyes of 30 consecutive patients with FTMH were prospectively studied (stage 2 = 2; stage 3 = 23; stage 4 = 5). All cases had surgery involving vitrectomy, injection of an autologous platelet aggregate over the hole and gas tamponade. At 3 months post-operatively all cases were assessed for closure of the FTMH, Snellen acuity and the incidence of complications. At this stage all patients completed a patient satisfaction questionnaire.**

Results **Anatomical closure of the hole was achieved in 83% of cases (25/30). Visual improvement of 2 Snellen lines or more occurred in 50% of cases (15/30). A vision of 6/12 or better was achieved in 27% of cases (8/30). A post-operative lens opacity was present in 46% (13/28) of phakic patients and a temporal, peripheral wedge-shaped field defect occurred in 17% (5/30) of cases. In this study, 53%, 70%, 57% and 67% of patients gave a positive response to specific questions about satisfaction with near, intermediate and distance vision and overall visual function respectively.**

Conclusions **Although the anatomical success of FTMH surgery is high the functional outcome in terms of Snellen acuity is less rewarding. Analysis of patient satisfaction suggests that the arbitrary visual outcome measures presently used may underestimate the functional benefit to the patient. Improved objective measures of visual outcome are required to assess the benefit of surgery in these cases.**

Key words Macular hole, Platelets, Visual function questionnaire

Idiopathic full thickness macular holes (FTMH) are an important cause of central visual loss in the elderly. More than 70% of cases are women in their seventh or eighth decade of life who present with central distortion and a reduction in visual acuity to the level of 6/36 or worse.[1–5] Various surgical strategies have been employed in the management of FTMH.[6–12] In principle these all involve vitrectomy combined with peeling of epiretinal tissue to relieve tangential traction and/or the use of biological modulators to stimulate a wound-healing process to close the hole. The results of surgery in terms of anatomical closure of the hole have been encouraging, with success ranging from 58% up to 100%. The results in terms of visual improvement have been more difficult to define and success has been arbitrarily defined, in most studies, as an improvement of 2 Snellen lines or more. Using this definition functional success ranges from 42% up to 90% in some studies. However, debate still continues on the overall benefit of surgery to the patient as 90% of the holes are unilateral and established holes are relatively non-progressive.[13–23] In addition, there can be significant surgical complications such as the development and progression of cataract[6,8,9] and the more recently recognised phenomenon of field loss.[24–26]

This paper reports on a prospective study of 30 consecutive patients who underwent FTMH surgery involving vitrectomy, instillation of autologous platelet aggregate and gas tamponade. Outcome was measured not only in terms of anatomical closure and improvement in Snellen acuity but also with regard to the incidence of complications and the patient's satisfaction as assessed by a visual function questionnaire.

Methods

Cases

Thirty eyes of 30 consecutive patients undergoing surgery for idiopathic FTMH between October 1995 and June 1996 were prospectively studied. Pre-operative details such as the nature and duration of symptoms,

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past ocular history and past medical history were recorded. Pre-operative best corrected Snellen visual acuity was recorded and the stage of FTMH graded according to the Gass classification.[1,2,27] Informed consent was obtained for surgery and all patients counselled as to the importance of post-operative posturing.

Surgical technique

Surgery was performed under either local or general anaesthesia within 3 weeks of our initial consultation with the patient. An identical surgical technique was used in all cases and was performed either by a vitreo-retinal consultant or by a fellow attached to the vitreo-retinal service.

One hour prior to surgery, a sterile venepuncture technique was used to obtain 16 ml of venous blood from the patient. This autologous sample was collected into a syringe containing 4 ml acid citrate dextrose (ACD) and centrifuged at room temperature at 150 *g* for 20 min. The platelet-rich plasma, devoid of red blood cells, was decanted off and mixed with 1/8th volume of ACD before a second centrifugation at room temperature at 1500 *g* for 10 min. The supernatant platelet-poor plasma was drawn off leaving a pellet of packed platelets that were resuspended in 0.6 ml of isotonic saline and then transported to the theatre. The average concentration of this autologous platelet aggregate was 10^9 platelets/ml.

A standard three-port pars plana core vitrectomy was performed in all cases. In stage 2 and 3 FTMH cases the posterior hyaloid face was detached from the disc by aspiration. In these cases and the stage 4 FTMH, with pre-existing posterior vitreous separation, the posterior vitreous cortex was removed as far out to the periphery as possible. A complete fluid–air exchange was then performed. No specific attempt was made to remove perifoveal epiretinal tissue or to aspirate subretinal fluid from the FTMH. Once the fluid–air exchange was complete, 0.1 ml of the sterile, autologous platelet aggregate was injected into the vitreous cavity directly over the FTMH. An air–16% C_3F_8 gas exchange was then performed.

The patient was postured supine for the first 24 h then face-down for the subsequent 10 days. Any per-operative complications were recorded and any retinal breaks noted were treated with cryopexy or laser photocoagulation. Any patients in whom the FTMH failed to close by 1 month following initial surgery were offered further repeat surgery using a fresh second dose of autologous platelets.

Outcome measures

All cases were reviewed at 1 day, 1 week, 1 month and 3 months post-operatively. At each visit best corrected Snellen acuity was recorded and a slit lamp examination and dilated fundal examination performed. At the 1 month post-operative review, when the intraocular gas bubble had diminished sufficiently to allow detailed macular examination, if the FTMH was still open then the patient was offered repeat surgery.

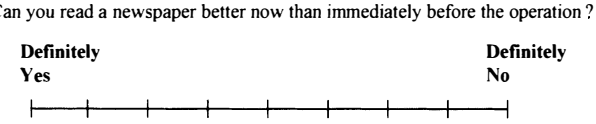

Fig. 1. *Sample question showing the visual analogue scale anchored at each end by a polarised description.*

The main outcome measures studied were anatomical closure, an improvement in Snellen acuity of 2 lines or more, the incidence of complications and patient satisfaction with the functional outcome. Anatomical outcome was taken as the state of the macula at 3 months after the initial or repeat surgery. The macular hole was considered closed if it was no longer visible or if the edges were still visible but flat with no surrounding subretinal fluid. The Snellen acuity outcome was taken as the best corrected acuity at 3 months after initial or repeat surgery. All per-operative and post-operative complications were recorded. Goldmann perimetry was performed on all eyes at 3 months post-operatively and visual fields assessed to a I4e white target.

In order to assess patient satisfaction with the functional outcome a short visual function questionnaire was developed. Five questions were asked to assess near and distance visual function, social limitation, overall satisfaction with the outcome and whether the patient would recommend surgery to another person. Rather than limit the responses to a yes/no format that forces patients to make extreme choices, a visual analogue scale anchored at each end by a polarised description was chosen for each question (Fig. 1). The patient marked a cross on the scale at a point in relation to the two polarised descriptions. The questionnaires were administered by a single doctor and all completed at the 3 month follow-up visit. For the purposes of analysis, the scale was divided into four equal categories (very positive response; positive response; negative response; very negative response). If a patient's response fell exactly on a dividing line between categories then it was taken as being in the more negative category.

Table 1. *Patient demographics*

Mean age (range)	67.7 years	(57–82 years)
Sex (*n*)		
Female	80%	(24/30)
Male	20%	(6/30)
Mean duration of symptoms (range)	9.4 months	(3–24 months)
Stage of FTMH (*n*)		
Stage 2	6.6%	(2/30)
Stage 3	76.7%	(23/30)
Stage 4	16.7%	(5/30)
Mode of anaesthesia (*n*)		
Local	77%	(23/30)
General	23%	(7/30)

Table 2. *FTMH closure rates*

All eyes (*n*)	83%	(25/30)
Stage of FTMH (*n*)		
Stage 2	100%	(2/2)
Stage 3	87%	(20/23)
Stage 4	60%	(3/5)
Duration of symptoms (*n*)		
< 6 months	92%	(12/13)
< 12 months	91%	(20/22)
> 12 months	63%	(5/8)

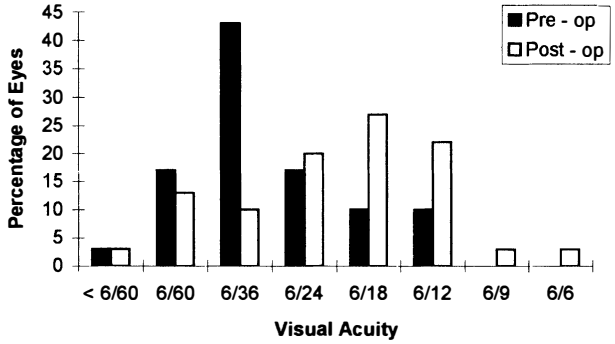

Fig. 2. *Pre- and post-operative Snellen visual acuities.*

Results

Demographics

Thirty eyes of 30 consecutive patients were entered into the study (Table 1). All were cases of idiopathic FTMH. The mean age of the patients was 67.6 years and 80% were female. The mean duration of symptoms was 9.4 months with a range from 3 up to 24 months. The most common presenting complaint was central distortion. The majority of eyes had stage 3 FTMH (76.7%), with fewer stage 4 (16.7%) and stage 2 holes (6.6%). Three of the patients had FTMH in the fellow eye (10%) but the second eye was not entered into this study as either the eye was operated on using an alternative surgical technique, the patient declined surgery or a decision was made to observe as good visual acuity was maintained. Twenty-eight of the eyes were phakic whilst 2 were pseudophakic. None of the phakic eyes was considered to have lens opacity sufficient to hinder examination of the macula or to require cataract surgery.

Anatomical outcome

Successful closure of the FTMH was achieved in 83% of eyes (25/30) with a single operation (Table 2). All patients in whom the hole failed to close were offered repeat surgery with a second dose of autologous platelets. Three cases did proceed to repeat surgery and all were anatomically successful. We are aware of no cases of late re-opening of any of the holes to date.

Analysis of the stage of the FTMH and closure rate showed that 100% (2/2) of stage 2 holes, 87% (20/23) of stage 3 holes and 60% (3/5) of stage 4 holes were closed with a single operation (Table 2). The improved closure rate for stage 2 and stage 3 FTMH compared with stage 4 FTMH was not statistically significant ($p = 0.16$; Fisher's Exact Test).

Analysis of duration of symptoms and closure rate showed a closure rate of 92% (12/13) for eyes with symptoms of less than 6 months' duration, 91% (20/22) for eyes with symptoms of less than 12 months' duration and 63% (5/8) for eyes with symptoms for longer than 12 months (Table 2). The improved closure rate for eyes with a symptom duration of less than 12 months compared with eyes with symptoms for longer than 12 months was not statistically significant ($p = 0.09$; Fisher's Exact Test).

Snellen visual acuity outcome

The median pre-operative Snellen acuity was 6/36, with a distribution from 6/12 to 6/60 or worse (Fig. 2). The median post-operative Snellen acuity was 6/18, with the distribution shifted towards better visual acuity (Fig. 2). Considering all eyes, anatomical successes and failures, then 50% (15/30) had an improvement in visual acuity of 2 Snellen lines or more (Table 3). Of these, 27% (8/30) reached a final Snellen acuity of 6/12 or better. All the cases that had an improvement in Snellen acuity of 2 lines or more were stage 3 FTMH.

Analysis of duration of symptoms and improvement in Snellen acuity of 2 lines or more showed that an improvement occurred in 77% (10/13) of eyes with symptoms of less than 6 months' duration, 59% (13/22) of eyes with symptoms of less than 12 months' duration and 25% (2/8) of eyes with symptoms for longer than 12 months (Table 4). The improved visual acuity outcome for eyes with symptom duration of less than 12 months compared with eyes with symptoms for longer than 12 months was not statistically significant ($p = 0.09$; Fisher's Exact Test). However, the improved visual acuity outcome for eyes with a symptom duration of less than 6 months compared with eyes with symptoms for longer

Table 3. *Change in post-operative Snellen activity compared with the pre-operative level*

Change in Snellen acuity	All eyes (*n* = 30)	FTMH closed after initial operation (*n* = 25)	FTMH closed after repeat operation (*n* = 3)	FTMH open (*n* = 2)
+ 2 lines or more	50% (15/30)	60% (15/25)	0 (0/3)	0 (0/2)
± 1 line	43% (13/30)	36% (9/25)	67% (2/3)	100% (2/2)
− 2 lines or more	7% (2/30)	4% (1/25)	33% (1/3)	0 (0/2)

Table 4. *Improvement in Snellen acuity of 2 lines or more according to the duration of symptoms*

All eyes (*n*)	50%	(15/30)
Duration of symptoms (*n*)		
< 6 months	77%	(10/13)
< 12 months	59%	(13/22)
> 12 months	25%	(2/8)

than 6 months was statistically significant ($p = 0.01$; Fisher's Exact Test).

If we consider only the eyes that had anatomical success after a single operation, 60% (15/25) had an improvement of 2 Snellen lines or more (Table 3). Of these eyes 32% reached a final Snellen acuity of 6/12 or better (8/25).

Although the 3 cases that had repeat surgery all had final anatomical success, none had an improvement in Snellen acuity of 2 lines or more.

Incidence of complications

There were several per- and post-operative complications noted in this study (Table 5). There were 2 cases of entry site retinal breaks noted at time of surgery. These were successfully treated per-operatively with cryopexy and neither progressed to retinal detachment. There were no cases of post-operative retinal breaks.

Eight cases had an intraocular pressure (IOP) rise to a level greater than 21 mmHg in the initial post-operative period. The mean IOP of these cases at 1 day post-operatively was 39 mmHg (range 26–60 mmHg). All these cases responded to topical beta-blockers and systemic acetazolamide with a reduction in IOP to below 21 mmHg within 1 month.

Post-operative visual field defects were found in 17% (5/30) of cases. All these field defects were found in cases of stage 2 FTMH (1/5) or stage 3 FTMH (4/5) which necessarily required detachment of the posterior hyaloid face from the optic disc during surgery. The FTMH had been closed in all the cases at initial surgery. Only 1 of the cases of field defect had an associated rise in IOP in the initial post-operative period. All the field defects were dense wedge-shaped defects extending from the temporal periphery to within 30° of fixation. Only 3 of the cases of field defect were symptomatic. None of the cases of post-operative field loss had symptoms of field loss prior to surgery.

Table 5. *Incidence of per- and post-operative complications*

Complication	Incidence
Retinal tears	7% (2/30)
High intraocular pressure	27% (8/30)
Visual field defects	17% (5/30)
Lens opacity	46% (13/28)

Nuclear sclerosis developed in 46% (13/28) of phakic cases over the period of the study. None of these cases had been noted to have lens opacity prior to surgery and none had surgery complicated by inadvertent lens touch. There were no cases of endophthalmitis.

Patient satisfaction

All the patients in the study completed the visual function questionnaire (Table 6). To assess near visual function the question was posed 'Can you read a newspaper better now than immediately before the operation?' To this question 53% gave a positive response with 50% giving a very positive response.

To assess the impact of surgery on social limitation and intermediate distance vision the question was posed 'When having a conversation with someone can you see their face better now than immediately before the operation?' To this question 70% gave a positive response with 53% giving a very positive response.

The effect of surgery on distance vision was assessed by posing the question 'Is your distance vision (e.g. seeing bus numbers or faces across the road) better now than immediately before the operation?' To this question 57% gave a positive response with 50% giving a very positive response.

To assess the patients' global change in visual function the question was posed 'Overall would you say your vision is better now than immediately before the operation?' To this question 67% gave a positive response with 53% giving a very positive response.

To assess whether the patients felt the surgical outcome was of sufficient benefit to recommend the procedure to someone else the question was posed 'Would you recommend this type of surgery to a friend or relative?' To this question 80% gave a positive response with 70% giving a very positive response. All

Table 6. *Summary of patients' positive and negative responses to the visual function questionnaire*

Question	Positive response	Very positive response	Negative response	Very negative response
Can you read a newspaper better now than immediately before the operation?	53%	50%	47%	43%
When having a conversation with someone can you see their face better now than immediately before the operation?	70%	53%	30%	30%
Is your distance vision (e.g. seeing bus numbers or faces across the road) better now than immediately before the operation?	57%	50%	43%	40%
Overall would you say your vision is better now than immediately before the operation?	67%	53%	33%	33%
Would you recommend this type of surgery to a friend or relative?	80%	70%	20%	20%

the positive answers were from patients who had anatomical closure of their FTMH at either initial or repeat surgery.

Discussion

Several surgical strategies for the management of FTMH have been developed over the past few years since Gass's hypothesis that the main cause of idiopathic hole formation is tangential traction on the fovea by adjacent adherent posterior cortical vitreous.[1,2] An early attempt at FTMH surgery by Kelly and Wendel[6] involving removal of the posterior cortical vitreous, peeling of epiretinal tissue when present and gas tamponade, showed promising results. In 52 stage 3 or 4 FTMH eyes they achieved anatomical closure in 58% (30/52), a visual acuity improvement of 2 lines or more in 42% (22/52) and 6/12 acuity or better in 21% (11/52).

In an attempt to improve on the early surgical results Glaser *et al*.[8] used a similar surgical approach but also used transforming growth factor-beta (TGF-β_2) as an adjunct to stimulate chorioretinal adhesion at the edge of the hole. Using a dose of 1300 ng TGF-β_2 there was anatomical closure in 100% of cases (11/11), a visual acuity improvement of 2 lines or more in 91% (10/11) and 6/12 acuity or better in 18% (2/11).

The surgical technique of meticulous epiretinal tissue peeling used in these studies was demanding, time-consuming and may actually cause tearing of the edge of the hole.[6,8] However, a further study demonstrated that epiretinal tissue removal could be avoided by using vitrectomy and TGF-β_2 alone without compromising the surgical results.[9] As TGF-β_2 is expensive and not readily available, other biological modulators have been used as adjuncts in FTMH surgery in different centres.[11,12] An autologous platelet aggregate has been used as an adjunct by Gaudric *et al*.[11] with anatomical closure in 95% of cases (19/20), a visual acuity improvement of 2 lines or more in 85% (17/20) and 6/12 acuity or better in 45% (9/20).

Despite the high anatomical closure rate in the above studies, the functional success, in terms of an improvement of 2 Snellen lines or more and the achievement of 6/12 acuity, has been much less rewarding. In addition these surgical interventions have been accompanied by a significant number of per- and post-operative complications including retinal tears and detachments,[7,8,12] retinal pigment epithelium disturbance,[6] cataract development[6–9] and peripheral visual field loss.[24–26] We must also consider that 90% of FTMH are unilateral[6,13–18] and the risk of developing a FTMH in a fellow eye with a pre-existing posterior vitreous detachment can be as low as 1%.[19,20] Also the natural history of FTMH suggests that only 29% of stage 3 holes and 13% of stage 4 holes will progress to a drop in visual acuity of 2 lines or more.[22] These factors must be taken into consideration when assessing the risk–benefit ratio in a particular patient.

Several authors have urged caution in the use of this type of invasive surgery and strict posturing regime in an elderly population with a relatively non-progressive and predominantly unilateral condition.[13,28,29] Some authors have tried to assess binocular visual function following FTMH surgery using objective methods. In one particular study, a one-step improvement in bilateral visual function (i.e. regaining reading vision or driving level vision) occurred in 15% of anatomically successful cases.[30] However, none of the studies published to date has attempted to assess the patients' satisfaction with the functional outcome of FTMH surgery.

Since October 1995 the vitreo-retinal service at Liverpool has adopted Gaudic's surgical approach, using autologous platelet aggregates as an adjunct in FTMH surgery. The anatomical success rate has been high, with 83% of holes being closed with a single operation. Repeat surgery has also been very successful in closing persistent holes. The precise mechanism by which platelets assist in closing a FTMH is unknown. Several histopathological studies have now supported a role for glial cells in sealing the FTMH deficit.[31–33] Presumably, the varied 'soup' of growth factors in the platelets could stimulate these glial cells and promote a wound-healing response to close the FTMH. A similar wound-healing response has been demonstrated by the use of platelets in the experimental management of spinal cord injury and chronic diabetic skin ulcers.[34,35] Numerous growth factors have now been identified in human platelets such as platelet derived growth factor, platelet derived angiogenesis factor, platelet factor IV, epidermal growth factor and TGF-β_2. However, it is not known whether these growth factors act alone or in combination in the closure of a FTMH. It is unlikely to be due solely to the effect of TGF-β_2 as 0.1 ml of platelet aggregate contains only 0.04 ng – an amount several orders of magnitude smaller than Glaser had success with.[36]

The functional results in our study – a 2 Snellen line improvement in 50% of cases and a best corrected acuity of 6/12 or better in 27% of cases – are comparable to those in most of the studies outlined above. All the cases that showed a 2 line improvement in visual acuity were stage 3 holes. However, in this study there were limited numbers of both stage 2 and stage 4 holes and so we cannot exclude the possibility in these groups that surgery may not improve visual acuity. The explanation for why some of the closed holes fail to have a corresponding improvement in visual acuity is unknown. The high incidence of lens opacity post-operatively in this study may have influenced the visual acuity outcomes. We would hope that when these cases have progressed to successful cataract surgery then a greater number would reach the 2 line improvement or 6/12 criteria. Indeed, Professor Gaudric has stressed that the visual outcome of macular hole surgery should only be assessed after cataract surgery (personal communication, Macular Hole Symposium, Annual Congress of the Royal College of Ophthalmologists, 1997).

However, this explanation alone does not account for all the cases of poor visual outcome in anatomically closed holes. In some cases of FTMH, histological studies

have shown photoreceptor and retinal pigment epithelium (RPE) degeneration surrounding the hole that might continue to influence the visual outcome post-operatively.[31,37] In addition, the operculum formed during FTMH development has recently been shown to contain not only fibroglial elements[38] but also neural retinal and photoreceptor tissue.[39] The extent to which this neural and photoreceptor tissue is lost in each individual case may vary and thus affect the functional outcome despite anatomical closure.

A significantly better visual outcome was achieved for those eyes with symptom duration of less than 6 months ($p = 0.01$). The length of symptom duration does not necessarily equate to the duration of the hole as it may be influenced by patient factors such as pre-existing visual acuity level and fellow eye visual acuity. However, the finding of a better visual acuity outcome with shorter symptom duration agrees with many previous studies.[6,7,12] The poorer outcome for those holes with longer symptom duration may reflect progressive photoreceptor and RPE degeneration around the FTMH as shown in histopathological studies.[31,37] However, this hypothesis is not supported by two clinicopathological case reports of surgically treated FTMH in which the surrounding photoreceptors and RPE were normal in appearance.[32,33] Of particular note, though, is that in one of these case reports the symptom duration was less than 6 months.[33]

Several per- and post-operative complications were noted in this study. The most common complication was the development of nuclear sclerosis (46%). The development or progression of nuclear sclerosis following vitrectomy for FTMH has previously been noted by many investigators.[6–9]

The early relatively high IOP noted in 27% of cases may be due to the use of an expansile gas/air mixture and may also be related to the supine posture in the first 24 h post-operatively. This complication responded well within weeks to temporary medical management and no long-term problems have been found.

We had only a low rate of retinal tears (7%) and these were all discovered and treated successfully per-operatively. The emphasis on sterile venepuncture technique and careful laboratory handling of the autologous platelets helped to prevent any cases of infective endophthalmitis in this study.

The recognition of post-operative field defects following FTMH surgery has stimulated much debate recently as to its exact incidence and aetiology.[24–26] In our study 5 patients with stage 2 or 3 FTMH (17%) developed a post-operative peripheral temporal defect. As we did not obtain pre-operative fields we cannot be certain that these cases occurred as a direct result of the surgery. However, 3 of these patients only became symptomatic following surgery and so it is unlikely that they had pre-existent field defects. The remaining 2 patients had asymptomatic field defects.

Several theories have been postulated to account for the field defect following FTMH surgery. These include direct trauma to the optic nerve head during surgery, damage to the peripapillary vasculature by surgical manipulation or gas tamponade, a peri-operative rise in IOP or indirect trauma to the optic nerve head during cortical vitreous peeling.[24–26] We favour this last mechanism because of certain clinical and anatomical correlates. It has been shown previously that 30% of autopsy eyes have an epipapillary membrane over the optic nerve head which is predominantly nasal.[40] These membranes have glial cell extensions linked through gaps in the internal limiting membrane to underlying optic nerve head glial tissue. During FTMH surgery, in which the posterior vitreous face needs to be detached from the disc, this epipapillary membrane would be peeled away causing indirect trauma to the underlying nerve fibre layer. This would explain why all our field defects occurred in stage 2 or 3 FTMH surgery and why all were temporal and peripheral in location. However, as previous studies have demonstrated field defects in stage 4 FTMH, other mechanisms such as a per-operative IOP rise or mechanical trauma involved in gas tamponade may also have a role.[25,26]

An important facet that has hitherto been unreported in previous studies of FTMH surgery is the level of patient satisfaction with their post-operative visual function. We designed a simple, short questionnaire to assess particular aspects of visual function relevant to the symptoms commonly described by patients with a FTMH. It has been shown that when patients are asked general questions of the benefit of surgery up to 80% give an affirmative answer.[41,42] Our use of specific questions helps to reduce the influence of the 'halo effect' whereby patients' perceptions of an outcome are clouded and shaped by their overall impression and respect for the surgeon treating them.[41] A similar approach has previously been used for assessing patient satisfaction with excimer laser surgery.[43]

In our present study, 53%, 70% and 57% of patients gave a positive response to specific questions about near, intermediate and distance vision respectively. The majority of these responses were very positive in nature. When asked about overall functional outcome after surgery 67% gave a positive response. The percentages of positive responses for patient satisfaction were higher than the percentages for visual acuity outcome in terms of a 2 Snellen line improvement or achieving 6/12 or better. Thus, these arbitrary measures of functional outcome may underestimate the benefit of surgery to the patient. Of particular note is that despite the burdens of post-operative posturing and the prospect of requiring further cataract surgery a large majority of patients (80%) would still recommend this form of surgery to a friend or relative.

We appreciate that there are certain limitations with any survey using our questionnaire. In particular, reliability and validity are difficult to evaluate because of its simplicity and the small sample population it was used with.[41] It may be more appropriate in further studies to use a standardised visual function questionnaire such as the one designed, and presently being extensively evaluated, by the National Eye

Institute.[44] By using such a standardised questionnaire, pre- and post-operatively, it may be possible to make comparisons of outcome measures with other surgical interventions and to assess the relative benefit of FTMH surgery.

In conclusion, our results demonstrate a high anatomical success rate for FTMH surgery but with a smaller proportion of patients having an improvement in visual function as assessed by Snellen acuity. However, if left untreated a significant proportion of stage 2 and 3 FTMH progress, leading to a deterioration in visual acuity.[22] For patients with relatively good pre-operative visual acuity, stabilisation rather than improvement may be a sufficient justification for surgery. The analysis of patient satisfaction suggests that the arbitrary visual outcome measures presently used may underestimate the functional benefit to the patient of this form of surgery. It may be more appropriate in further studies to include other measures of functional outcome such as contrast sensitivity, reading acuity/speed and microperimetry to assess changes in central scotomas. The relatively high incidence of complications of post-operative lens opacity and peripheral field loss need to be considered along with the above factors in the debate as to the risk–benefit ratio of FTMH surgery.

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