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Original Research

The impact of surgery on self-reported metamorphopsia and vision-related quality of life in patients with an idiopathic full-thickness macular hole

ORIGINAL RESEARCH

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ABSTRACT

Background: Metamorphopsia (distorted vision) is among the most common symptoms reported by patients with idiopathic full-thickness macular hole (iFTMH) and is related to significant deterioration in Vision-Related Quality-of-Life (VRQoL). Surgical closure with pars plana vitrectomy (PPV) is the chief determinant of visual acuity postoperatively, but the extent of visual improvement is variable. This study aimed to assess the impact of surgery on the self-reported prevalence and severity of metamorphopsia and the VRQoL in patients with an iFTMH.

Methods: A prospective consecutive case series study was performed. The Metamorphopsia Questionnaire (MeMoQ) and the National Eye Institute Visual Functioning Questionnaire - 39 (VFQ-39; assesses the VRQoL) were completed by patients before and three months post-PPV for iFTMH. The patient cohort (N=30) included 9 men and 21 women ages 47-89 years who underwent operations between 01/07/2019-12/11/2020 at St Paul's Eye Uni, Liverpool. The pre-and post-operative presence and severity of metamorphopsia were highlighted through a severity scale with a maximum of 9 points for the 9 questions in the MeMoQ. Responses for the VFQ-39 were categorised into subscales as per the VFQ-39 guidance. Wilcoxon signed-rank test was performed for each subscale to identify subscales with a statistically significant improvement post-PPV.

Results: There was a statistically significant improvement of metamorphopsia ($p<0.05$) following surgery, with a mean reduction in severity of 2.18 points. In the VFQ-25, a statistically significant improvement ($p<0.05$) was seen in the following subscales: general vision, near activities, distance activities, social functioning, mental health, role difficulties, dependency, driving and peripheral vision.

Discussion: This study highlights the significant improvement of metamorphopsia associated with an enhancement in vision in patients who underwent vitrectomy for FTMH. The significant improvement in mental health is particularly interesting in this COVID era where patients are susceptible to an increased risk of mental health deterioration.

BACKGROUND

The vitreous humour is a transparent, clear, gel-like substance responsible for the stabilisation of the eyeball. As part of the normal aging process, the vitreous humour undergoes progressive liquefaction, with collapse of its constituent collagen fibrils, leading to complete posterior vitreous detachment (PVD) from the retina. Normal age PVD may be complicated by vitreomacular adhesions between the vitreous cortex and the macula. If persistent, the vitreomacular adhesions result in traction on the retina due to the liquefaction of the vitreous, which in turn can lead to the development of a full-thickness macular hole (FTMH). (1) This can also be named idiopathic (iFTMH) if no secondary causes are identified.

iFTMHs are a common cause of significant visual impairment, with a prevalence of up to 1:400 of those aged over 60 years. (2) Since the macula is responsible for central vision, patients presenting to the clinics usually complain of reduced visual acuity (VA), metamorphopsia (distorted vision), and loss of social interactions can be affected, causing a reduction in the Vision-Related Quality of Life (VRQoL).

Macular holes are now routinely treated surgically via vitrectomy, where the aim is to close the hole, which ideally results in an improvement in VA. The success rates are high at over 90%, depending on several factors, including hole size. (4)

Generally, objective parameters, such as VA and successful closure of a macular hole, are used to assess postoperative outcomes. However, these measures do not provide information on the subjective aspects of visual function and patient wellbeing. Therefore, assessing subjective and objective outcomes can provide a much better understanding of the overall impact of the disease and treatment on such patients.

Some studies have investigated metamorphopsia in various retinal disorders and its association with VRQoL. (5-12) Although a few studies have investigated the effect of vitrectomy on VRQoL in patients with a macular hole, no studies have investigated the change in VRQoL for patients with an iFTMH in the context of the COVID pandemic (6, 10). Therefore, this study aimed to assess metamorphopsia and VRQoL following surgical treatment for idiopathic full-thickness macular holes.

METHODS

A prospective consecutive case series study of 30 eyes of 30 consecutive patients operated on at St. Paul's Eye Unit, Liverpool. Of the 30 patients, 9 were male and 21 female, with an age range of 47-82 years. All cases included were operated on by a single surgeon, between 01/07/2019 and 20/02/2021. The surgical technique consisted of pars plana vitrectomy (PPV), removal of the Internal limiting membrane (ILM), and perfluoroethane (C2F6) as gas tamponade. Informed consent was obtained from each participant for the study. Inclusion criteria were patients with a confirmed diagnosis of an idiopathic full-thickness macular hole. Exclusion criteria included patients with co-existing ocular pathology in the index (affected) eye. This study was part of a service evaluation and did not require research ethical approval.

MeMoQ	
Item	Description
1	Do the lines of a crosswalk or the steps of an overpass appear distorted to you?
2	Do telephone poles or trees appear tilted to you?
3	Do the curtain rails in your house appear distorted or tilted to you?
4	Do the frames of windows or bookshelves appear distorted to you?
5	Do the lines of the tiles on your bathroom wall appear distorted or tilted to you?
6	Does the outline of your television set appear distorted or tilted to you?
7	Do people's faces appear distorted to you? Do the parts of the faces also appear missing?
8	Does your face appear distorted to you in the mirror?
9	When reading a book, newspaper or display on a computer screen, do the lines of words appear distorted to you?

Figure 1: *The MeMoQ; highlighting the nine questions asked regarding metamorphopsia severity. (4)*

The presence (and severity) of metamorphopsia was based on the patient's self-reported perception of abnormal vision quality as evaluated using the adjusted Metamorphopsia Questionnaire (MeMoQ) (Version 1.0) developed by Arimura et al. (2018) (Figure 1). (13) Patients also completed the National Eye Institute Visual Functioning Questionnaire – 39 (VFQ-39) to assess the VRQoL (Figure 2). (14) Data was completed by patients at baseline and approximately 3 months after surgery. The pre-and post-operative presence and severity of metamorphopsia were evaluated through a severity scale with a maximum of 9 points (maximum severity) for the 9 questions in the MeMoQ. In line with the questionnaire's scoring guidance, the prevalence of metamorphopsia was defined as a MeMoQ score over 0 and the severity of metamorphopsia was based on the total number of "Yes" responses. The difference in the means of pre-and post-op MeMoQ was calculated to compare the changes to the severity of metamorphopsia 3 months following surgery.

The VFQ-39 questionnaire is an extended version of the more commonly used VFQ-25 questionnaire. (14) This extended version contains 39 questions rather than 25 and means that the statistical power of the results is greater for the same sample size. The 39 questions were categorised into 1 of 12 subscales: general health, general vision, ocular pain, near activities, distance activities, social functioning, mental health, role difficulties, dependency, driving, colour vision, and peripheral vision. Response scoring (ranging from 0-100 where 100 indicates the best score) was done according to the guidance provided by the National Eye Institute. (14) An overall composite score for each questionnaire was calculated to assess the change in the VRQoL at 3 months following surgery. A composite score was also calculated for each subscale; the Wilcoxon signed-rank test was performed to identify subscales with a statistically significant mean improvement among the patients post-PPV. The psychometric properties of the VFQ-39 questionnaire have been tested and deemed as robust for an array of eye conditions, including macular holes. (14)

Figure 2: *The visual functioning questionnaire; highlighting the 12 subscales assessed using 39 questions. (5)*

No.	Items	Subscales
1	General health	General health
2	General vision	General vision
3	Worry about eyesight	Mental health
4	Pain around eyes	Ocular pain
5	Reading normal newsprint	Near vision
6	Seeing well up close	Near vision
7	Finding objects on crowded shelf	Near vision
8	Street signs	Distance vision
9	Going downstairs at night	Distance vision
10	Seeing objects off to side	Peripheral vision
11	Seeing how people react	Social function
12	Matching clothes	Colour vision
13	Visiting others	Social function
14	Going out to movies/plays	Distance vision
15	Driving in daylight	Driving
16	Driving in difficult conditions	Driving
17	Accomplish less	Role limitations
18	Limited endurance	Role limitations
19	Amount of time in pain	Ocular pain
20	Stay home most of the time	Dependency
21	Frustrated	Mental health
22	No control	Mental health
23	Rely too much on others' words	Dependency
24	Need much help from others	Dependency
25	Embarrassment	Mental health
26	Overall health	General health
27	Eyesight	General vision
28	Reading small print	Near vision
29	Figuring out bills	Near vision
30	Shaving, styling, makeup	Near vision
31	Recognising familiar faces across room	Distance vision
32	Participating in active sport/outdoor activities	Distance vision
33	Seeing and enjoying TV programmes	Distance vision
34	Entertaining friends and family at home	Social function
35	Driving in difficult conditions	Driving
36	Help required	Role limitations
37	Limitation in activities	Role limitations
38	Irritability	Wellbeing, distress and dependency
39	Going out alone	Wellbeing, distress and Dependency

Table 1: *The 12 subscales of the VFQ-39 questionnaire alongside the mean difference in the composite score of each subscale (pre-op – post-op).*

SUBSCALE	NUMBER OF RESPONSES	MEAN DIFFERENCE (Pre-Post)	CONFIDENCE INTERVAL		WILCOXON SIGNED RANK TEST
			Upper bound	Lower Bound	
General Health	30	0.8333	5.0274	-4.5728	0.866
General Vision	30	-11.3333	-3.7197	-17.1894	0.001
Ocular Pain	30	-2.9167	6.9801	-8.1165	0.388
Near Activities	30	-16.0556	-6.4694	-22.5458	<0.001
Distance Activities	30	-14.4306	-4.9263	-21.7404	<0.001
Social Functioning	30	-4.7222	.3461	-10.9522	0.013
Mental Health	30	-17.1667	-9.8669	-27.8604	<0.001
Role Difficulties	30	-9.1667	-.1844	-17.4293	0.012
Dependency	30	-4.7917	.1639	-10.9594	0.011
Driving	22	-21.0227	-7.9413	-34.1042	0.003
Colour Vision	30	-2.5	2.8007	-9.6188	0.257
Peripheral Vision	30	-12.5	-2.4327	-24.8401	0.008

RESULTS

Data were recorded for 30 patients (9 Male, 21 Female) with an age range of 47–82 years operated between 01/07/2019 - 12/11/2020. The mean age was 72.1 years, with a 95% CI lying between 74.77 and 69.36 years.

The pre-and 3-month postoperative comparison of the MeMoQ highlighted an improvement of metamorphopsia in 15 patients, no change in the severity of metamorphopsia in 9 patients, and a worsening of metamorphopsia in 4 patients. Overall, metamorphopsia at 3 months following surgery improved by 2.179 points (95% CI: Upper Bound: 3.715, Lower Bound: 0.642) (Table 1). Two patients failed to return a completed 3-month post-op MeMoQ, so were excluded from the analysis.

Concerning the VFQ-39, a mean increase of 10.33 points in the overall composite score post-operatively compared to the pre-operative composite score (Improvement 95% CI: Upper Bound: 5.81; Lower Bound: 14.86) was found.

Table 1 highlights the subscales that were part of the VFQ-39, along with the mean difference between the 3-month post-op questionnaires compared to the pre-op. The driving subscale was answered by 22 out of 30 patients as 8 patients either never drove or had stopped driving for reasons other than eyesight. The Wilcoxon signed-rank test result highlights whether a statistically significant difference existed between the pre- and 3-month post-operative composite scores for each subscale. A statistically significant difference was noted in the following subscales: General Vision ($p = 0.001$), Near Activities ($p = <0.001$), Distance Activities ($p = <0.001$), Social Functioning ($p = 0.013$), Mental Health ($p = <0.001$), Role Difficulties ($p = 0.012$), Dependency ($p = 0.011$), Driving ($p- = 0.003$) and Peripheral Vision ($p = 0.008$).

Figure 3 highlights the questions that comprised the mental health subscale. These questions related to themes of frustration, lack of control, worry and irritability - all of which can directly impact the mental health of an individual.

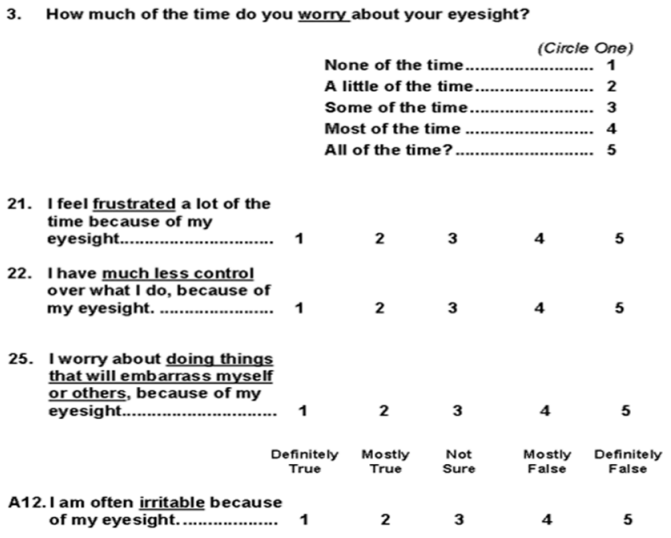

Figure 3: *The questions asked in the VFQ-39 to assess the patient mental health.*

DISCUSSION

This study highlights the positive impact of pars plana vitrectomy in several key domains of vision related quality of life, notably mental health, as well as the near and distance activities.

Though the treatment of iFTMH is surgical with a high probability of anatomical success, the improvement in vision is variable. The growing emphasis on providing maximal cost-benefit output on the health outcome of patients stimulates interest in future decision-making. Ophthalmologists currently assess the effectiveness of the surgery primarily by assessing retinal anatomical outcomes with Optical Coherence Tomography (OCT) and VA in the operated eye. This method of assessing effectiveness, though may provide information regarding the objective vision, fails to consider the patient's subjective vision. The subjective vision takes into consideration the degree of metamorphopsia and other visual abnormalities that may affect the vision despite a quantitative improvement of the VA on the Snellen/LogMAR chart. Thus, subjective vision impairment can lead to a negative impact on the wellbeing and quality of life, mental health, and social participation in affected individuals. This has been shown in a study investigating the relationship between the effect of metamorphopsia on the VRQoL. (3) Utilising the MeMoQ and the VFQ-25, the same study found that patients with self-reported metamorphopsia had a considerably lower VRQoL compared to the patients with metamorphopsia. (3) Tranos et. al (2006) also demonstrated that the VFQ-25 score was significantly associated with the severity of postoperative metamorphopsia after vitrectomy. (15) This highlights the utility of metamorphopsia assessment tools such as the VFQ-39, which should be used with VA post-operatively to provide quantitative data on the patient outcomes and experiences following surgery.

Our results were consistent with other studies that have reported a reduction in metamorphopsia after surgery using tools other than the MeMoQ to assess metamorphopsia. Krøyer et al. (2010) and Fukuyama et al. (2020) utilised M-CHARTS for the assessment of metamorphopsia post-operatively, whereas McGowan et al. (2016) utilised D-Charts. (16–18) All three studies concluded a significant reduction in the metamorphopsia at 6-months and 1-, 3- and 6-months post-op, respectively. (16–18) The consistency with these studies on the reduction in the severity of metamorphopsia reflects the adequacy of the MeMoQ as a tool for assessing metamorphopsia.

Our results showed an overall improvement in the VRQoL at 3 months following surgery. Looking at the individual subscales highlighted in Table 1, the General Health, Ocular Pain and Colour Vision showed no statistically significant difference between the pre-and post-operative responses ($p > 0.05$). The Ocular Pain subscale is not a feature associated with macular holes, so will be excluded from the discussion. A statistically significant improvement was seen in the 9 other subscales: General Vision, Near Activities, Distance Activities, Social Functioning, Mental Health, Role Difficulties, Dependency, Driving and Peripheral Vision. It is interesting to note that the driving subscale showed the greatest improvement (34.10) followed closely by mental health

(27.86). However, the driving subscale was based on data from 22 patients, whereas the mental health subscale was based on data from 30 patients.

Fukuda et al. (2009) investigated the effect of vitrectomy for patients with a macular hole by utilising M-CHARTS and VFQ-25 (25 questions) to assess the metamorphopsia and VRQoL, respectively. (6) They found that vitrectomy significantly improved the overall VFQ-25 composite score. (6) Comparing the subscale composite scores, they found a statistically significant improvement in the following subscales for the 32 patients included in their study: general vision, near activities, distance activities, social functioning, mental health and dependency. (6) These subscales also showed a statistically significant improvement within our study: general vision, near activities, distance activities, social functioning, mental health and dependency. The repeatability of findings in our study with other studies highlights the positive impact of a vitrectomy in improving key domains of visual function and thus having an overall positive impact on the quality of life of patients. Reducing the dependency of patients on others draws light to the long-term positive consequences of the procedure. With reduced dependency on others, patients may continue with their activities of daily living and reduce their reliance on carers (if any). For patients with a package of care in place at their own home, it could mean that they continue living at home and not require their care to be escalated to involve more carers, or even a transfer to a care-home or nursing home.

Considering the VFQ-39, there could be an overlap between subscales, as problems with near and distance activities could affect driving, which would in turn affect the dependency of an individual and hence their mental health. As a negative impact on the other subscales could indirectly impact the mental health of an individual, the findings related to the mental health of the patients will be the focus of the discussion below.

Mental health and the COVID-19 pandemic

The advent of the COVID-19 pandemic has brought a multitude of challenges across several aspects of living. Regarding the impact on healthcare, there has been a significant reduction in the number of surgeries performed across the UK. This effect has been seen within ophthalmology departments, with elective surgeries being cancelled and emergencies prioritised. This delay has affected thousands of eye patients across the country, as ophthalmology is among the busiest outpatient-based specialties.

A study conducted a questionnaire-based survey to investigate the psychological impact of the COVID-19 pandemic lockdown on people living with eye diseases in the UK (19). Of all 325 respondents with visual impairment, the lockdown had negatively impacted mental health in 45.9% of cases (19). The study went on to emphasise the importance of recognising and providing additional psychosocial support to this vulnerable group of people during the pandemic (19). The findings of this study pose the question of whether vitrectomies for subacute macular disease, such as a macular hole, should be delayed or postponed, especially during the COVID era?

As our study findings suggest a statistically significant improvement in the mental health of patients at 3 months following surgery, it would be beneficial for patients with a macular hole to have surgery at the appropriate time, rather than be delayed. Alongside mental health, subscales such as driving, independence and social functioning also showed a statistically significant mean improvement. As these subscales could indirectly contribute towards the mental health of the patient, they should be considered as components of mental health assessment. Priority should be given to allow sufferers to return as close to their normal function in each of the subscales of the VFQ-39 as early as possible. In addition, studies have suggested that the size of a macular hole increases with an increase in waiting time. (20) With larger-sized macular holes, the probability of successful closure of the hole following surgery is lower. (21) This finding, compiled with other evidence highlighting the positive correlation of an increase in the waiting time with a reduced chance of improvement in visual acuity, implies that the delay in follow-up and care could result in significant and/or permanent harm to vision. (21) Although macular hole repair is not an urgent pathology, considering the effect on mental health and the problems described in the literature, we can contribute to improving the wellbeing of such a vulnerable population by operating on them earlier. Ideally we should aim to prioritise the mental health of such patients by continuing with their surgery without delay.

However, if a delay in the treatment for a macular hole is inevitable, for instance due to other emergency procedures, various measures could be implemented to provide support for such patients. An article exploring wellbeing and mental health during the COVID-19 outbreak highlighted several key points which clinicians should bear in mind when approaching the vulnerable group of patients with chronic eye disorders (22). Among these, the author emphasised the importance of ensuring that mental and physical wellbeing is a component of the response in the health services. (22) By providing patients with time during clinics, addressing fears, stigma and the impact on mental health can be comforting for patients and highlight the support doctors can provide. Such patients can also be directed towards relevant psychological support services provided by primary care doctors to ensure that this vulnerable group is not neglected. (22) Eye Clinic Liaison Officers (ECLO) can be helpful to provide patients with emotional support during challenging times. Screening tools, such as mental health questionnaires, could be utilised in primary care to highlight individuals in urgent need of support. Alongside providing advice to patients on mental wellbeing, Cullen et al (2020) also supported the view that to do so, care for doctors' mental health would be paramount, as this will allow them to cope themselves and continue to support others. (22) Acting on these points would ensure that patients are left satisfied with the response provided by the medical team, and this could in turn help alleviate some of the stresses associated with living with chronic eye disorders.

Strengths and limitations:

The main strength of this study was the application of reliable and valid questionnaires. The MeMoQ is a valid tool to assess patients' subjective perception of metamorphopsia and could supplement traditional methods of quantifying metamorphopsia, i.e. M-CHARTS and Preferential Hyperacuity Perimetry (PHP). (13) Further, the VFQ-39 was utilised rather than the VFQ-25, which enhanced the power of the study and the reliability of the results. One of the main limitations of the study was the reduced sample size. This was partly due to the impact of the COVID pandemic, meaning that fewer patients were seen. Although the 3-month post-op follow up was used for most cases, there were a few cases that were seen slightly after the 3-month mark. This occurred because clinics were cancelled and set for later dates to prioritise emergencies. In addition, the responses of patients could also be argued to be subjective and there may be variations in the degree of a response based on the same severity of the symptom.

Further studies should consider following up on the patients for a longer period (6 months, 12 months) after surgery to assess the trend in the VRQoL. Studies could also investigate how often mental health is explored and addressed during ophthalmology consultations. This may foreshadow the introduction of changes to practice to ensure that patients feel supported in all aspects of their care.

Conclusion

This study highlights the positive impact of vitrectomy on the VRQoL and the mental health of patients with an iFTMH. The COVID pandemic has impacted the mental health of patients with eye diseases in the UK. Although macular hole surgery is not urgent, with consideration to the effect on mental health and the problems described in the literature, we should aim to improve mental health by limiting cancellations and delays to operating on such a vulnerable population. Regardless, mental health will remain an issue during COVID and beyond. It should be addressed by considering earlier surgery and supporting patients as holistic clinicians and guiding patients to the relevant services.

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