Metamorphopsia before and after macular hole surgery

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Introduction

- Full-thickness macular holes (FTMHs) cause decreased best-corrected visual acuity (BCVA) and metamorphopsia, where straight lines appear warped or distorted[1].
- Metamorphopsia can be measured objectively using M-Charts in the vertical (M-Chart V) or horizontal (M-Chart H) plane (min 0, max 2.4), and subjectively using a metamorphopsia questionnaire (MeMoQ)(min 0, max 18)[2,3].
- Pre-op and post-op BCVA is widely reported, despite reports that metamorphopsia, not BCVA, is the main variable associated with poor pre-op and post-op vision-related quality of life[4].
- Identifying why some patients suffer from greater post-op metamorphopsia is important.

Methods

- This was a prospective, observational, single-centre feasibility study of patients with primary FTMH.
- BCVA, M-Chart and MeMoQ scores were recorded pre-op and 6-months post-op.
- Symptom duration before surgery was recorded. SD-OCT measurements included minimum linear diameter (MLD) of the FTMH preoperatively *(figure 1)*, whilst ellipsoid zone defect length *(figure 2)* and the presence of external limiting membrane (ELM) defects *(figure 3)* were measured postoperatively. The relationship between these factors and post-op metamorphopsia was investigated.
- "Low severity" metamorphopsia was defined as a MeMoQ score ≤1, equivalent to only "sometimes" experiencing metamorphopsia in 1 out of 9 everyday visual stimuli or less, an interesting clinical endpoint.
- Predictors of "low severity" symptomatic post-op metamorphopsia score were evaluated.

Results

- Due to the exploratory nature of our study and multiple comparisons, a **p-value <0.02** was deemed significant.
- 58 eyes of 58 patients were included in the study.

Metamorphopsia improved postoperatively in all measures

- Only 25 patients attended both study visits.

n=25	Preoperative	6-month postoperative	p-value
M-Chart V	1.1 (0.8-2.0)	0.3 (0.0-0.7)	**<0.001**
M-Chart H	0.8 (0.3-1.5)	0.2 (0.0-0.6)	**0.009**
MeMoQ	5 (2-10)	1 (1-6)	**0.011**

Mean (IQR): p-value from Wilcoxon-signed rank test

Objective and subjective metamorphopsia measures did not correlate preoperatively or postoperatively

Preoperative	M-Chart V	M-Chart H
M-Chart H	$r_s(28)=0.759$ **p<0.001**	
MeMoQ	$r_s(27)=-0.060$ p=0.757	$r_s(27)=0.161$ p=0.403

Postoperative	M-Chart V	M-Chart H
M-Chart H	$r_s(46)=0.672$ **p<0.001**	
MeMoQ	$r_s(46)=0.180$ p=0.220	$r_s(46)=0.292$ p=0.044

$R_s(n-2)$=spearman's rank correlation coefficient

OCT parameters did not correlate with postoperative metamorphopsia, whilst symptom duration correlated with postoperative M-Chart H

	M-Chart V	M-Chart H	MeMoQ
Symptom duration	$r_s(44)=0.252$ p=0.091	$r_s(44)=0.388$ **p=0.008**	$r_s(44)=0.047$ p=0.758
MLD	$r_s(46)=0.021$ p=0.888	$r_s(46)=-0.124$ p=0.403	$r_s(46)=0.075$ p=0.610
EZ defect	$r_s(43)=-0.002$ p=0.990	$r_s(43)=0.016$ p=0.916	$r_s(43)=0.130$ p=0.393
ELM defect	p=0.146*	p=0.567*	p=0.071*

**p-value from Mann-Whitney U test*

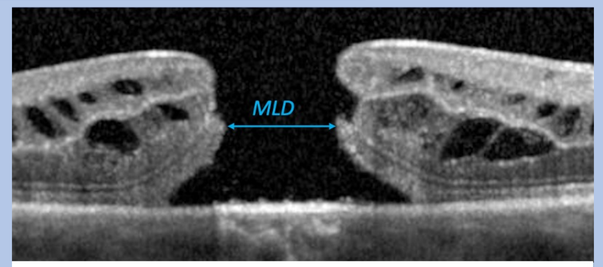


Figure 1 – Preoperative SD-OCT: MLD dimension of FTMHs

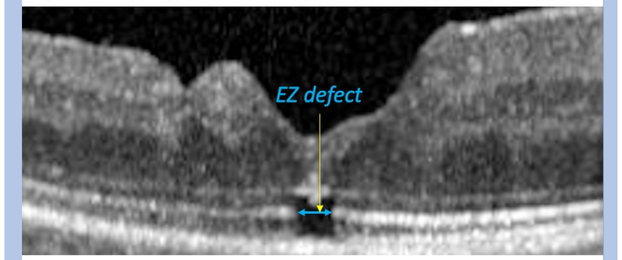


Figure 2 – Postoperative SD-OCT: EZ defect measurements

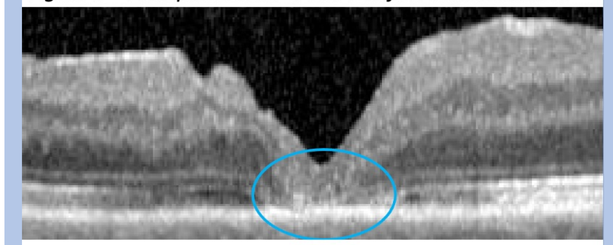


Figure 3 – Postoperative SD-OCT: Full-thickness ELM defect

References

1. Ezra E. Idiopathic full thickness macular hole: natural history and pathogenesis. Br J Ophthalmol. 2001;85(1):102-8.
2. Matsumoto C, Arimura E, Okuyama S, Takada S, Hashimoto S, Shimomura Y. Quantification of metamorphopsia in patients with epiretinal membranes. Invest Ophthalmol Vis Sci. 2003;44(9):4012-6.
3. Arimura E, Matsumoto C, Nomoto H, Hashimoto S, Takada S, Okuyama S, et al. Correlations between M-CHARTS and PHP findings and subjective perception of metamorphopsia in patients with macular diseases. Invest Ophthalmol Vis Sci. 2011;52(1):128-35.
4. Fukuda S, Okamoto F, Yuasa M, Kunikata T, Okamoto Y, Hiraoka T, et al. Vision-related quality of life and visual function in patients undergoing vitrectomy, gas tamponade and cataract surgery for macular hole. Br J Ophthalmol. 2009;93(12):1595-9.

Results

No potential predictors of "low severity" subjective postoperative metamorphopsia severity were identified

- Univariate analysis of the "low" postoperative metamorphopsia category against potential predictors identified two factors (p<0.200) for forward selection likelihood ratio-based multivariate logistic regression: **Preoperative MeMoQ** and **postoperative full-thickness ELM defect.**
- Subsequent multivariate logistic regression deemed both unsuitable for input into the predictive model.

Variable	p-value
Age[1]	p=0.794
Sex[3]	p=0.583
Duration of symptoms[2]	p=0.903
Preoperative BCVA[2]	p=0.574
Preoperative M-Chart mean[1]	p=0.511
Preoperative MeMoQ[2]	**p=0.110**
MLD[1]	p=0.613
Postoperative EZ defect[2]	p=0.516
Postoperative ELM hyperreflective foveal defect[3]	**p=0.061**

p-values from unpaired T tests[1], Mann Whitney U test[2], Fisher's exact test[3]

Conclusions

- Surgery treats both objective and subjective metamorphopsia.
- Low post-op metamorphopsia remains unpredictable.
- Objective metamorphopsia does not appear to correlate with the frequency of subjective metamorphopsia, as assessed by MeMoQ.
- Patient non-attendance (due to COVID) renders this study statistically underpowered to exclude associations; symptom duration is most probably also correlated to post-op M-Chart V.
- Measurements of postoperative photoreceptor defects did not correlate with metamorphopsia, signifying that simple hole closure is not solely responsible for the resolution of metamorphopsia.