



Prevalence and predictors of metamorphopsia after successful vitrectomy surgery for macula-off rhegmatogenous retinal detachment

Prévalence et prédicteurs des métamorphopsies après vitrectomie réussie pour un décollement de rétine rhéghmatogène avec macula soulevée

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ABSTRACT

Aim: To estimate metamorphopsia prevalence, predictors and etiologies in patients operated for rhegmatogenous retinal detachment (RRD) with detached macula with successful results.

Methods: Retrospective study including 50 eyes of 50 patients who underwent pars plana vitrectomy for RRD with detached macula with standard silicone oil (SO) tamponade. Patients who had successful surgery with durable anatomic reapplication of the retina after SO removal were included. Patients were examined on day 1, day 7, 1 month, and 3 months after surgery. Best corrected visual acuity, Amsler grid, fundus biomicroscopy, Spectral Domain Optical Coherence Tomography (SD-OCT) and fundus auto-fluorescence (FAF) were performed in all patients after surgery. Structural abnormalities such as macular folds, macular epiretinal membrane, cystoid macular edema, and foveal disruption of the ellipsoid layer were observed on SD-OCT. Macular displacement was identified on FAF.

Results: We identified metamorphopsia as post-operative visual impairment in 27 patients among 50 (54%). Clinical assessment found that a delay > 7 days between symptoms and surgery ($p < 0.001$), more than 2 detached quadrants ($p = 0.012$), and stage C of proliferative vitreoretinopathy ($p = 0.035$) were associated to metamorphopsia. Regarding multimodal imaging findings, only macular folds and macular displacement were significantly correlated with the occurrence of postoperative metamorphopsia ($p < 0.001$).

Conclusion: Metamorphopsia is a common complaint after vitrectomy for RRD. Macular rotation and folds would be the main causes after complete and durable reapplication of the retina.

Keywords: Rhegmatogenous retinal detachment, Metamorphopsia, Vitrectomy, Multimodal imaging.

RÉSUMÉ

Objectif : Estimer la prévalence, les facteurs prédictifs et les étiologies des métamorphopsies chez les patients opérés pour un décollement de rétine rhéghmatogène (RRR) avec macula soulevée avec de bons résultats finaux.

Méthodes : Étude rétrospective incluant 50 yeux de 50 patients vitrectomisés pour DRR avec macula décollée et tamponnement standard par de l'huile de silicone (HS). Les patients ayant une chirurgie réussie avec réapplication anatomique durable de la rétine après ablation du HS ont été inclus. Les patients ont été examinés à j1, j7, à 1 mois et à 3 mois après chirurgie. La meilleure acuité visuelle corrigée, la grille d'Amsler, l'examen du fond d'œil, la tomographie par cohérence optique (SD-OCT) et l'autofluorescence du fond d'œil (FAF) ont été réalisées chez tous les patients après la chirurgie. Les anomalies structurelles, telles que des plis maculaires, une membrane épimaculaire, un œdème maculaire cystoïde et une altération de la couche ellipsoïde fovéale ont été observées en SD-PCT. Le déplacement maculaire a été diagnostiqué sur les clichés de FAF.

Résultats : Nous avons identifié des métamorphopsies postopératoires chez 27 patients parmi 50 (54%). Sur le plan clinique, un délai supérieur à 7 jours entre le début des symptômes et la chirurgie ($p < 0,001$), un nombre de quadrants décollés supérieur à deux ($p = 0,012$) et un stade C de prolifération vitréo-rétinienne ($p = 0,035$) ont été significativement associés à la survenue de métamorphopsies. En imagerie multimodale, seuls les plis rétinien maculaires et le déplacement maculaire étaient significativement corrélés à la survenue de métamorphopsies postopératoires ($p < 0,001$).

Conclusion : La métamorphopsie est une plainte fréquente après vitrectomie pour DRR. La rotation et les plis maculaires seraient les principales causes après réapplication complète et durable de la rétine.

Mots clés : Décollement de rétine rhéghmatogène, Métamorphopsie, Vitrectomie, Imagerie multimodale.

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INTRODUCTION

Pars plana vitrectomy is the most effective technique for rhegmatogenous retinal detachment (RRD) management. To date, retinal reapplication rate exceeds 90% (1). However, successful anatomical reapplication doesn't mean a good visual function recovery, especially in cases of RRD associated to detached macula. Different studies showed that almost 30% of patients complained of postoperative metamorphopsia (1–4). In studies including only macula-off cases, the incidence of metamorphopsia was much higher, ranging from 66.7% to 88.6 (5–7). The exact physiopathology of such metamorphopsia remains poorly understood, but it is considered to be an objective sign of retinal distortion and macular displacement (8). Nowadays, multimodal imaging offers, thanks to different sectioning and scanning techniques, a more in-depth analysis of the macula region. Spectral Domain optical coherence tomography (SD-OCT) helps to analyze microstructural changes of neuroretina explaining metamorphopsia occurrence.

This study aimed to estimate the prevalence of metamorphopsia in patients operated for RRD with detached macula. We also discussed its etiologies after successful vitreoretinal surgery, based on multimodal imaging findings.

METHODS

Study Design

This is a post-hoc study conducted in the Department A of Hedi Raies Institute of Ophthalmology (Tunis, Tunisia) over the period from July 2019 to January 2020

Participants

We included 50 eyes of 50 patients operated by pars plana vitrectomy and standard silicone oil tamponade for macula-off RRD with successful surgery, total and durable retinal reapplication after silicone oil removal. Minimal postoperative follow-up was 6 months. Non-inclusion criteria were giant tear's RRD, traumatic RRD, RRD with severe proliferative vitreoretinopathy (PVR) (stage > C3), patients with diabetes or other systemic pathologies that may affect the retinal microstructures and patients with a history of chronic maculopathies (dystrophies or degenerations), follow-up < 6 months, and incomplete files.

Data collection

All patients underwent, a complete ophthalmological exam preoperatively including best corrected visual acuity (BCVA) using the Snellen visual acuity chart and fundus exam. Postoperatively, all patients were examined on day 7, 1 month, 3 months and 6 months. At 3-month follow-up, we measured the BCVA and checked for the presence of metamorphopsia using the Amsler grid. SD-OCT (Heidelberg® Spectralis®) with B-scan centered on the fovea and fundus autofluorescence (FAF) were performed. Microstructural changes and postoperative abnormalities such as epiretinal membrane, cystoid macular edema, macular hole and subretinal fluid were documented. On FAF, hyperautofluorescence lines parallel to retinal vessels were interpreted as evidence of retinal displacement.

Surgical technique

All patients underwent a 23-gauge pars plana vitrectomy (PPV). A complete central and peripheral vitrectomy (Figure 1 A, B) was performed with posterior mechanical vitreous detachment. After stabilization of the posterior pole by perfluorocarbon Liquid (PFCL) (Figure 1C), retinectomy of the tear edges was performed. We performed a dissection of epiretinal membranes and vitreo-retinal proliferation under PFCL (Figure 1D). Then, we proceeded to laser retinopexy (Figure 1E) and/or cryopexy and PFCL-silicone oil exchange for all patients (Figure 1F).

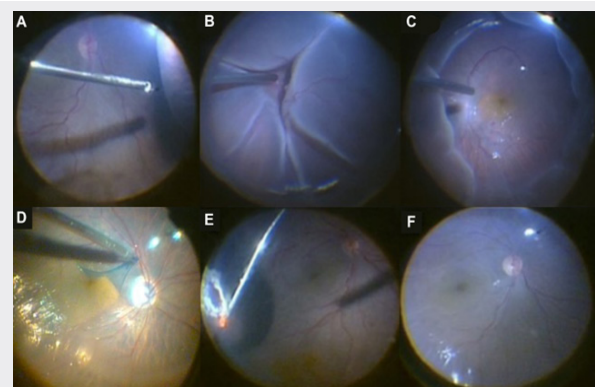


Figure 1. Surgical technique: (A) Peripheral vitrectomy with indentation (B) Bullous total rhegmatogenous retinal detachment with detached macula (C) Reapplication of the macula using perfluorocarbon liquid (PFCL) (D) Central epiretinal proliferative membrane dissection under PFCL (E) Endolaser retinopexy (F) PFCL-silicone oil exchange.

Statistical analysis

We used the Statistical Package for the Social Sciences (SPSS) program version 21.0 (IBM Corp. Armonk, New York, NY, USA) for statistical analysis. Visual acuity was

converted from decimal to LogMAR. Qualitative results were expressed in frequencies and percentages. Quantitative data were expressed as mean ± standard deviation (SD). To compare categorical findings, we used the Chi-square test (χ^2) or the exact Fisher test. To compare quantitative variables, Student t-test was employed. All tests were considered significant for a value of $p < 0.05$.

RESULTS

A total of 50 eyes of 50 patients were included. The average age was 40 ± 15 years [25-82]. A male predominance was recorded (32 males). 19 patients were pseudophakic (38%). Metamorphopsia was clinically assessed by patient interviewing and Amsler grid in 27 patients (54%). Autofluorescence imaging objectified retinal displacement in 16/27 patients (59.25%) (Figure 2).

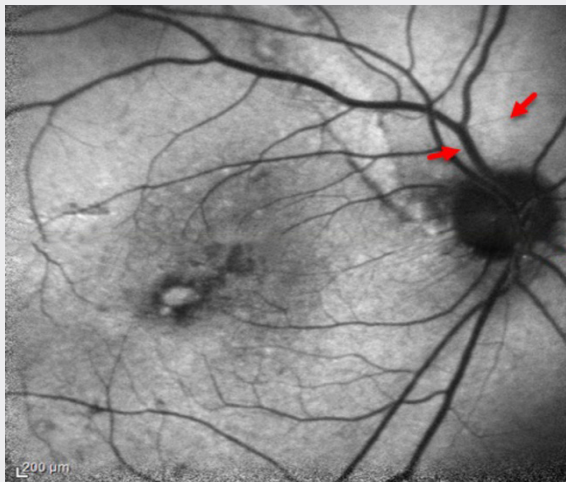


Figure 2. Fundus Auto-fluorescence image showing macular postoperative displacement: red arrows pointing to hyperfluorescent lines indicate the preoperative position of the retinal vessels.

Clinically, the rate of postoperative metamorphopsia was significantly dependent on the duration between initial symptoms and surgery (> 7 days, $p < 0.001$), the number of detached retinal quadrants (> 2 quadrants, $p = 0.012$) as well as the stage of proliferative vitreoretinopathy (Stage C, $p = 0.035$). In the 27 patients with metamorphopsia, SD-OCT identified macular epiretinal membrane (Figure 3a), macular folds (Figure 3b), cystoid macular edema (Figure 3c), and ellipsoid zone distortion (Figure 3d), in respectively 6/27 (22.2%),

15/27 (55.6%), 5/27 (18.5%) and 10/27 (37%) of patients.

Regarding structural parameters, only macular displacement ($p < 0.001$) and macular folds ($p < 0.001$) were significantly correlated with postoperative metamorphopsia.

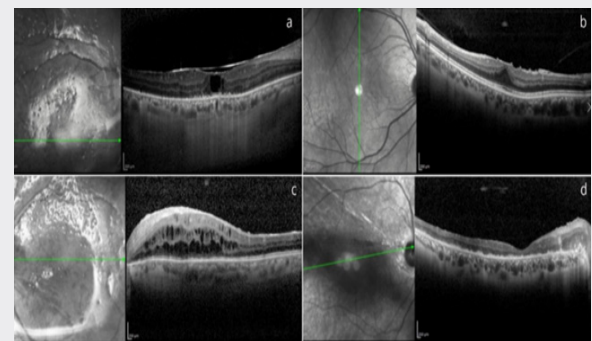


Figure 3. Postoperative macular SD-OCT abnormalities: (a) Macular epiretinal membrane, (b) Macular folds (c) cystoid macular edema (d) distortion of the ellipsoid area.

Table 1 summarizes the correlation of metamorphopsia with clinical findings and multimodal imaging (SD-OCT and FAF).

Table 1. Correlation of metamorphopsia with clinical, FAF and SD-OCT findings.

	Variables	Metamorphopsia (N = 50)		p-value
		Yes (27/50) n (%)	No (23/50) n (%)	
CLINICAL FINDINGS	Delay between symptoms and surgery (> 7 days)			< 0.001
	Yes	22 (44%)	5 (10%)	
	No	5 (10%)	18 (36%)	
CLINICAL FINDINGS	Number of detached retinal quadrants (> 2)			0.012
	Yes	19 (38%)	8 (16%)	
	No	8 (16%)	15 (30%)	
CLINICAL FINDINGS	Stage of proliferative vitreoretinopathy			0.035
	Stage C1, C2	15 (30%)	6 (12%)	
	Stage A, B	12 (24%)	17 (34%)	
FAF	Macular displacement			< 0.001
	Yes	16 (32%)	1 (2%)	
	No	11 (22%)	22 (44%)	
FAF	Macular folds			< 0.001
	Yes	15 (30%)	2 (4%)	
	No	12 (24%)	21 (42%)	
OCT	Macular epiretinal membrane			0.07
	Yes	6 (12%)	1 (2%)	
	No	21 (42%)	22 (44%)	
OCT	Cystoid macular edema			0.91
	Yes	5 (10%)	4 (8%)	
	No	22 (44%)	19 (38%)	
OCT	Ellipsoid zone distortion			0.44
	Yes	10 (20%)	11 (22%)	
	No	17 (34%)	12 (24%)	

The mean final BCVA, at 6 months, was 0.39 LogMAR (4/10 on the Snellen scale). It was not correlated with the presence of metamorphopsia ($p = 0.96$). However, the final visual acuity was

statistically correlated to the presence of macular epiretinal membrane ($p < 0.001$) and ellipsoid zone distortion ($p = 0.048$).

DISCUSSION

Our study showed that after successful RRD surgery, metamorphopsia is a common functional disorder diagnosed in 54% of participants treated for RRD and associated with macular displacement in 59% of cases. Retinal folds were the tomographic abnormalities most likely to cause metamorphopsia ($p < 0.001$). According to the literature, the prevalence of metamorphopsia after macula-Off RRD surgery, all techniques included (pars plana vitrectomy/scleral buckling surgery), ranged from 66.7 to 88.6% (1,2,8,9). This wide variation in the prevalence of postoperative metamorphopsia in the literature (10) is mainly due to the size of the study population, the mean age, the type of surgery, the tamponade, the ability of the surgeon, the follow-up and the methods used to diagnose metamorphopsia.

Delay of metamorphopsia after surgery varied from 6 months to 33 months according to the literature (8,10). In a long-term follow-up study, Rossetti et al (7) concluded that the importance of metamorphopsia decreased with time and a complete disappearance was objectively observed in 3% of patients after 6 years of observation.

The exact pathophysiology of postoperative metamorphopsia is still not fully clarified. Several hypotheses were discussed in the literature. Two studies concluded that there was no significant correlation between postoperative tomographic abnormalities and metamorphopsia (5,7). Besides, many studies reported a highly positive relationship between tomographic disruptions of the external limiting membrane following RRD surgery, and the development of metamorphopsia (3,4,8). According to our results, the presence of macular epiretinal membrane, residual sub-retinal fluid, cystoid macular edema, and ellipsoid zone disruptions are not significantly correlated with postoperative metamorphopsia. Furthermore, we have identified macular displacement and folds as being significantly associated with postoperative metamorphopsia. The diagnosis can be made easily using FAF. Our findings are in line with most studies showing that FAF can diagnose infraclinical macular displacement after pars plana vitrectomy for RRD (1-3,10,11).

Finally, through our study, we found that postoperative metamorphopsia did not influence the final corrected

visual acuity, unlike Zhou et al (10) and Van Put et al (5) who reported that metamorphopsia was associated with distortions of the retinal layers with poor final visual acuity.

There are limitations to our study, such as retrospective design, limited sample size (50 eyes), and a short follow-up time (6 months). Larger and more expanded prospective studies may achieve more conclusive results.

CONCLUSION

Postoperative metamorphopsia could be related to a major macular displacement, which may result in retinal distortions. Thus, the main interest would be to find out how to reduce the macular slide during the pars plana vitrectomy.

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