Correlation of fundus autofluorescence and spectral domain OCT findings of the macula with visual outcome after successful repair of rhegmatogenous retinal detachment

A thesis
Submitted by

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Background

Successful reattachment of the macula after RD is often associated with incomplete visual recovery. Preoperative factors influencing macula recovery include preoperative visual acuity, duration and height of detachment, and vitreomacular traction (Abouzeid and Wolfensberger, 2006). Even with a normal-appearing macula on examination, patients often experience visual impairment.

Macular recovery after surgery for retinal detachment depends on preoperative and postoperative predictive factors. Preoperative visual acuity is the main preoperative factor correlating positively with good macular recovery. Preoperative factors, which influence macular recovery negatively, include duration of macular detachment, height of macular detachment and vitreomacular traction. Postoperative factors, which influence macular recovery negatively, include cystoid macular edema, epiretinal membranes, retinal folds, subretinal retinal pigment epithelium (RPE) migration and persistent subretinal fluid (Abouzeid and Wolfensberger, 2006).

Since its introduction, optical coherence tomography (OCT) has become an indispensable tool in evaluating the macula. OCT produces cross-sectional images of the retina with longitudinal resolution of 10 micron. OCT is unique in its cross-sectional scanning of the tissue which provides anatomic tomographic representation of the retinal layers and their pathologies (Drexler et al., 2001).
Ultra-high-resolution OCT system has already been reported with axial resolution of 2 to 3 micron allowing visualization of retinal layers comparable to images obtained with histopathology (Drexler et al., 2001).

The advent of spectral domain-optical coherence tomography (sd-OCT) has permitted, without invasive intervention; it helped explaining visual loss after RD repair. OCT has elucidated several postoperative factors correlating with poor vision. These features include persistent SRF and increased foveal thickness (Muraine et al., 2005; Avitabile et al., 2006), demonstrating as well the submacular fluid that couldn’t be detected clinically (Seo, et al., 2008).

OCT helped in acquiring pathological data in vivo showing that persistent foveal detachment, distortion and disruption of outer retinal layers (ORLs) and macular folds following successful surgery for RD (Schocket et al., 2006; Mura M et al., 2012).

OCT has also been used to demonstrate central foveal thickness, and outer nuclear layer thickness. The presence or absence of epiretinal membrane, intraretinal fluid, and subretinal fluid are assessed. The status of the external limiting membrane, inner/outer segment junction, and intermediate line can also be evaluated and judged as disrupted or complete by the OCT. Macular holes and small RPE detachments may be also detected. All these findings are important predictors of postoperative visual outcome after anatomically successful rhegmatogenous retinal detachment repair (Gharbiya et al., 2012).
More recently, fundus autofluorescence (FAF), an *in vivo* noninvasive imaging modality which relies primarily on the fluorescence generated from the bisretinoids of lipofuscin in retinal pigment epithelial cells. It is used for metabolic mapping of naturally or pathologically occurring fluorophores of the ocular fundus (Holz et al., 2007).

The dominant sources are fluorophores such as A2-E in lipofuscin granules that accumulate in the postmitotic retinal pigment epithelium as a by-product of the incomplete degradation of photoreceptor outer segments (Holz et al., 2007).

FAF imaging may allow for identification of retinal diseases when these are not otherwise evident. Metabolic changes at the level of the photoreceptor/RPE complex may not be visualized by funduscopy or other routine imaging techniques such as fluorescein angiography. This is particularly helpful to investigate patients with unknown visual loss (Poloschek et al., 2008).

Several lines of evidence suggest that excessive lipofuscin accumulation represents a common downstream pathogenic pathway in various hereditary and complex retinal diseases. Focally increased FAF, and therefore, excessive RPE lipofuscin load, may indicate dysfunctioning RPE cells (Dandekar et al., 2005; Sparrow and Boulton, 2005).

FAF has been used to investigate the morphological and functional changes occurring after RD repair. Shiragami et al. Showed in 2010 that in patients with large bullous RDs, shifting of the retina from its original position can frequently be observed after vitrectomy and is detected by FAF.
The mark of the displacement consist of lines of increased auto fluorescence that closely reflect the caliber and orientation of the adjacent retinal vessels to which the lines are related.

Some of these lines correspond on OCT to hyper reflective lesions at the level of the outer retinal layers (Mura et al., 2012). The same study showed an interesting feature in the form of sharply demarcated skip changes in reflectivity of the inner segment/outer segment (IS/OS) line on OCT corresponding to thin lines of increased auto fluorescence on FAF. These lines were termed “IS/OS skip reflectivity abnormalities” (IS/OS skip RAs) (Mura et al., 2012).
Aim of the work

The aim of our study is to investigate the structure-function relationship of the macula, by correlating fundus autofluorescence, optical coherence tomography, and visual acuity following successful repair of rhegmatogenous retinal detachment.

Patients and methods

Type of the study:

Our study is a prospective observational case series study on 20 eyes.

Inclusion criteria:

Patients who underwent successful surgical repair of rhegmatogenous retinal detachment with ≤ two procedures were included in this study.

Exclusion criteria:

- Preexisting macular pathology such as age-related macular degeneration, macular hole, macular edema or diabetic maculopathy.
- Tractional retinal detachment.
- Exudative retinal detachment.
- Traumatic maculopathy and traumatic retinal detachment.
- Recurrent retinal detachment twice or more.
- Significant postoperative media opacities interfering with the OCT and FAF imaging.
- Eyes with uveitis, glaucoma, or retinal vascular occlusive diseases.
**Population study:**

The study will be applied on twenty eyes, after having postoperative successful repair of rhegmatogeous retinal detachment.

**Pre-operative examination:**

All patients will undergo complete ophthalmological examination before surgery, including:

- Best corrected visual acuity (according to the Snellen chart).
- Slit lamp examination.
- IOP assessment.
- Dilated fundus examination by binocular indirect slit lamp bimicroscopy and indirect ophthalmoscopy.

**Surgical approach:**

Vitrectomy using 20 G or 23 G or scleral buckle will be done according to:

- The duration, site, extent and height of the retinal detachment.
- Number and type of the breaks.
- The macula status on\off.
- PVR grading.
Primary outcome parameters:

To assess the macular anatomical and micro-structural details obtained by spectral domain-OCT and fundus autofluorescence correlated with best corrected visual acuity following retinal reattachment.

Secondary outcome parameters:

To assess post-operative complications.

Post-operative examination and follow up:

- Complete routine ophthalmological examination will be done on the first week post-operative, then 1 month post-operative.

Examination will include:

- BCVA (using Snellen chart)
- Slit lamp examination
- Dilated fundus examination using indirect ophthalmoscopy and binocular slit lamp bimicroscopy
- IOP assessment

- Macular OCT and FAF will be done at 3 and six months intervals post-operative; after stabilizing the retinal reattachment and silicone removal.
**Statistical analysis:**

Data will be presented in terms of parametric and non-parametric data. Parametric data will be analyzed with ANOVA and whenever appropriate with student t test. Non-parametric data will be analyzed with Chi-square and/or Whitney Mann tests. Statistical significance will be considered at 95% confidence interval.
References

- **Abouzeid H. and Wolfensberger Th J.:** Macular recovery after retinal detachment. *Acta Ophthalmologica Scandinavica* vol. 84 issue 5 October 2006. p. 597-605.


