The refractive impact of subretinal fluid in neovascular age-related macular degeneration

Schou, Marianne Guldager; Thinggaard, Benjamin Sommer; Hajari, Javad Nouri; Klefter, Oliver Niels; Grauslund, Jakob; Subhi, Yousif

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TABLE OF CONTENTS STATEMENT

Patients with neovascular age-related macular degeneration are often recommended to wait until all subretinal fluid has disappeared before scheduling an appointment with their optician. This is ascribed to the refractive impact of the anterior displacement of photoreceptors by subretinal fluid. This paper demonstrates that subfoveal fluid with a maximum height of 75 μm does not lead to a clinically significant refractive impact. Thus, the recommendation of waiting for complete subretinal fluid resolution can be nuanced.

Patients with neovascular age-related macular degeneration (AMD) undergo intravitreal treatment in various treatment and follow-up regimens.[1,2] During these follow-ups, many patients understandably ask when it would be appropriate to schedule an appointment with their optician for new glasses. Since subretinal fluid (SRF) leads to anterior displacement of the photoreceptors and a refractive — hypermetropic — shift, patients are often recommended to wait until a complete removal of SRF.[3,4]

Complete removal of SRF is not always possible and for some eyes this is only achieved for brief periods.[1,2] Thus, in medical retina clinics, we occasionally meet patients who are frustrated with their newly purchased glasses, who experience to get different information about purchasing new glasses from their doctor and optician,[5] or who have refrained from ordering new glasses for several years upon commencement of intravitreal treatment. From a theoretical standpoint, one might speculate, whether there is a level of SRF and photoreceptor displacement that is below the threshold of clinical significance. In other words, is it possible to refine the recommendation to wait until the SRF is completely gone? To explore this, we examined the refractive impact of SRF. From a practical point of view, we defined clinical significance to be a +0.25 D change, as this typically is the smallest difference in refractive measurements in glasses.

The refractive impact of SRF is based on the anterior displacement of the photoreceptors, and we needed a formula to predict the spherical equivalent refractive error at the corneal plane in diopters as a function of the axial length. Morgan *et al.* reported the following predictive relationship between the axial length A (mm), the mean anterior corneal radius of curvature (mm) K, and the spherical equivalent refractive error at the corneal plane S (diopters)[6]:

$$1/A = 0.22273/K + 0.00070S + 0.01368$$

We used this formula to explore the impact of SRFs of various sizes in eyes with an axial length of 22, 24, and 26 mm, and a mean anterior corneal radius of curvature of 7.5, 7.7, and 7.9 mm. We assumed that the size of the SRFs would proportionally decrease the axial length. Hence, the effective axial length was assumed to change from 24.0 mm to 23.9 mm in a patient with an SRF height of 100 μm.

We calculated the refractive changes for 63 scenarios with various SRF heights, axial lengths, and corneal radii of curvature (Table 1). As this paper is based on calculations based on previous publications and no original data sampling from humans, no institutional review board approvals were needed. For SRF heights ranging from 10 to 200 μm, the hyperopic shift ranged from 0.02 to 0.60 D. The smallest axial lengths and largest SRF heights resulted in the highest hyperopic shifts. Across all the modelled axial lengths and corneal radii of curvature, an SRF of 75 μm or lower led to a hyperopic shift of maximum 0.22 D.

It should be acknowledged that the accuracy of these estimates is dependent on the accuracy of the formula by Morgan *et al.*[6] and they found this formula to be accurate in adults in their 20ies. The accuracy of this formula in the elderly remains unexplored. Moreover, subretinal fluid is not always present in the foveal area in AMD, lesions can be extrafoveal or even peripheral.[7–10] In such cases, the impact on the refraction should be even more limited and interpreted with care. Fluids in other compartments may also have an impact. While both pigment epithelium detachments and SRF lead to anterior displacement of the photoreceptors, intraretinal fluid (IRF) do not displace photoreceptors in the anterior-posterior plan unless the IRF is large. However, IRF leads to a greater visual impact,[11] which may challenge the subjective refraction and accuracy at the optician, which should be considered when counselling the patient.

Assuming that our calculations are reasonably accurate, waiting for an SRF of 50–75 μm or lower to subside completely should not lead to any clinically significant refractive impact. Hence, it is our understanding that it could be possible to nuance to the recommendation of waiting until the SRF is completely gone. While optimizing treatments to ensure the patients can read yet another letter using the best-corrected visual acuity, we should not forget that the patients spend most of the time with their routine correction, which should also be as optimal as possible. Our recommendation also approaches the patient from a holistic point of view, as it enables the ophthalmologist to also advise on how to rationalize spending on visual aids in a patient population that is often retired, living on pension, and therefore focused on minimizing spending. Studies highlight the importance of a good patient-physician communication and relationship in retinal diseases such as AMD as it can have a significant impact on understanding the rationale for continuing treatment and adherence to therapy.[12]

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Table 1
Calculated refractive changes in diopters (D) with different scenarios of axial length (AL) in mm, anterior corneal radius of curvatures (K) in mm, and subretinal fluid (SRF) height in μm.

AL (mm)	22	22	22	24	24	24	26	26	26
K (mm)	7.5	7.7	7.9	7.5	7.7	7.9	7.5	7.7	7.9
SRF size (μm)									
10	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02
25	0.07	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05
50	0.15	0.15	0.15	0.12	0.12	0.12	0.11	0.11	0.11
75	0.22	0.22	0.22	0.19	0.19	0.19	0.16	0.16	0.16
100	0.30	0.30	0.30	0.25	0.25	0.25	0.21	0.21	0.21
150	0.45	0.45	0.45	0.37	0.37	0.37	0.32	0.32	0.32
200	0.60	0.60	0.60	0.50	0.50	0.50	0.43	0.43	0.43

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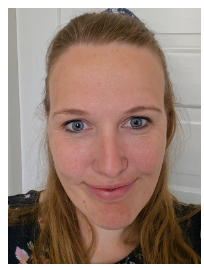

Marianne Guldager Schou, MD finished her medical degree from the University of Copenhagen, Denmark and is currently on leave from her residency training in ophthalmology to pursue a PhD fellowship at the University of Southern Denmark and Odense University Hospital in Odense, Denmark. Her research focuses on pharmacoepidemiology and treatment of age-related macular degeneration.

Marianne Guldager Schou[a,b,*], Benjamin Sommer Thinggaard[a,b], Javad Nouri Hajari[c,d], Oliver Niels Klefter[c,d], Jakob Grauslund[a,b,e], Yousif Subhi[b,c,f]

[a] *Department of Ophthalmology, Odense University Hospital, Odense, Denmark*
[b] *Department of Clinical Research, University of Southern Denmark, Odense, Denmark*
[c] *Department of Ophthalmology, Rigshospitalet, Glostrup, Denmark*
[d] *Department of Clinical Medicine, University of Copenhagen, Copenhagen, Denmark*
[e] *Department of Ophthalmology, Vestfold Hospital Trust, Tønsberg, Norway*
[f] *Department of Ophthalmology, Zealand University Hospital, Roskilde, Denmark*

[*] Corresponding author at: Department of Clinical Research, University of Southern Denmark, J.B. Winsløws Vej 19, DK-5000 Odense, Denmark.
E-mail address: marianne.guldager.schou@rsyd.dk (M.G. Schou).