Purpose

The computer-based app AMD - A Metamorphopsia Detector® was developed to provide a home monitoring tool to detect, measure and control the degree and size of metamorphopsia and scotomas. This study was performed to examine sensitivity and specificity of AMD - A Metamorphopsia Detector® and its correlation with anatomical course, functional development and quality of life. Our goal was to make metamorphopsia measurable, lower the diagnostic threshold and enhance persistence and adherence for diagnosis and therapy in order to detect macular pathology in time.

AMD - A Metamorphopsia Detector® is based on the Amisler grid®. The software uses the concept of a negative image; a distorted image can be straightened by moving the mouse. Degree and dimension of distorted lines or scotoma are transformed into indices, central findings are over-represented.

Method

I. In a pretest sensitivity, specificity, objectivity, reliability and construct validity of the AMD - A Metamorphopsia Detector® Metamorphopsia Module were examined in 34 patients (68 eyes) age 37-91: 13 exudative age-related maculopathy, 40 normal macula, 1 keratoretinal(1) without macular pathology, 1 macular edema due to central venous thrombosis, 1 macular pucker, 10 macular drusen(2), 1 diabetic macular edema, 1 central serous retinopathy(3).

II. In a second step 19 eyes (age 24-91) with SD-OCT documented maculopathies performed the metamorphopsia module alone or in combination with the scotoma module as well as the gold standard Amisler Test (age-related macular degeneration with macular edema = 5, age-related macular degeneration with macular drusen = 10, macular pucker = 2, myopic macular degeneration = 1, central serous retinopathy (RCS) = 1).

III. In a prospective observational clinical pilot study we examined monocular best corrected distance visual acuity (logMAR, BCVA), vision related quality of life (National Eye Institute Visual Function Questionnaire NEI VFQ 25), slit lamp and dilated fundus exam, SD-OCT (spectral domain optical coherence tomography), Optomap fundus photography, and performed Amisler grid and the AMD - A Metamorphopsia Detector® Metamorphopsia Module with appropriate near correction in 13 eyes of 13 caucasian patients (6 males, 7 females, age 37-91) with macular edema before and after a therapy cycle of 3 intravitreal injections with an anti-vascular endothelial growth factor. The diagnoses for treatment were age-related wet MD = 12, myopic MD = 1) Accompanying ocular diseases were glaucoma in 1 eye; 1 eye developed clinically significant cataract during the study.

All data were collected according to GCP (good clinical practice) and GSP (good statistical practice) as described in the Helsinki 1995 resp. Edinburgh 2000 declaration. Prior to the study all patients signed informed consent.

Results

I. Pretests confirmed objectivity, reliability and construct validity. In healthy eyes both Amisler and AMD showed no pathological findings. Reliability was proved by repeating AMD in the same setting several hours later. When screening for macular pathology, sensitivity of AMD was 88%, specificity was 97%. x²-Test lead to rejection of the zero hypothesis (x² = 3.94; freedom degree = 1, α = 0.05).

II. When a wider range of macular pathologies was included, addition of the scotoma module increased sensitivity from 0.88 to 0.94.

One eye with RCS was detected by neither module. The likelihood to detect macular pathologies without metamorphopsia was improved (OR 3.37; 95% CI 0.94 - 5.67) by combining both app modules.

Results III: Correlation of AMD-index, OCT, VA and QL

III. All parameters changed significantly after treatment: a-VEGF improved OCT and AMD-index in all 13 eyes. Average decrease of central retinal thickness (CRT) was 77.54 μm (median 55 μm; SD 49.99; CI 111.74, 43.33), average decrease of AMD-index was 6.0 (median 4.76; SD 3.5; CI 7.9, 4.1). BCVA improved in 9 (5 blue bubbles), deteriorated in 1 (grey bubble) and was stable in 3 patients (small bubbles). Geometric mean BCVA was 0.38 logMAR (SD 0.28) before and 0.25 logMAR (SD 0.21) after treatment (COI 0.21; 0.03). NEI VFQ 25 increased (QL) in 11 (mean 8.77; median 19; SD 12.39; CI 17.74, 3.65) and got worse (QL) in 2 patients. one developed cataract and VA deteriorated as well, one was stable in VA but experienced visual field problems due to glaucoma. AMD-index results represented the majority of trends in OCT, BCVA, Amisler Test and NEI VFQ 25.

Discussion

As an easy to use, economic mobile or at home test, the AMD App can easily enhance self-effacy, persistence and adherence in diseases associated with macular edema by lowering the diagnostic threshold and support early detection of macular pathologies and recurrences. In bright areas without easy access to ophthalmology services, the AMD App may play a role as a public health instrument and support early diagnosis and control of macular diseases. The results of COVARE, AURA and CHARM Study(4,5) revealed that in clinical reality too few injections were given. By increasing the number of patients showing up for diagnostic procedures and control in time, AMD - A Metamorphopsia Detector® can help reduce the economic burden of visual disability(6) and improve vision related quality of life(7).

Bias

Intensified contact with the ophthalmologist while performing the AMD Test might lead to observer bias. Selection bias may occur when patients with low VA and those who are dissatisfied with therapy are reluctant to participate in the study. They would consequently not be represented. Undiagnosed diseases could be reasons for information bias.

Limitation and Confounders

Interpretation of results is limited by small group size. Confounders: one patient developed cataract during treatment and thus experienced deterioration of visual acuity in spite of decreased index - presumably NEI VFQ 25 got worse for the same reason. BCVA before therapy, age, sex, a caring and empathic doctor, therapy adherence, transport problems might be considered as a risk (or chance) for the examined result which is associated with exposure but not a cause for it.

Conclusion and Perspective

As a quantitative and operationalizable test AMD - A Metamorphopsia Detector® can support screening, early detection and (re-)monitoring of macular disease by lowering the threshold for diagnosis, enhancing self-effacy(8), compliance and adherence for exams and therapy in age related macular degeneration and other diseases leading to macular pathology. Encrypted transmission of vision, trend analysis and graphical result can supplement ophthalmological diagnostics. By supporting (potential) patients and medical staff, the AMD App may improve quality of life and diminish economical consequences of visual impairment. Ongoing studies examine the correlation between changes in OCT, VA, and AMD-index by stratification and comparison of quality of life in groups with and without access to COVARE. AURA and CHARM Study.

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