Purpose

AMD – A Metamorphopsia Detector (patient pending) is the first computer-based interactive tool to detect, quantitatively measure, document, compare and control the degree, localization and area of metamorphopsias. Quantification of metamorphopsias using the Metamorphopsia Detector provides documentation of a patient-reported outcome and is a tool to evaluate burden of disease and quality of life. This tool can be used to monitor patients with the aim to improve diagnostic compliance, enhance therapy adherence, reduce therapy drop-out and support disease management programs.

This study investigates the correlation of AMD – A Metamorphopsia Detector's Metamorphopsia Index with central retinal thickness and examines the test's sensitivity and specificity for anatomic or for clinically relevant findings, respectively, with or without macular diseases.

Material and Methods

AMD – A Metamorphopsia Detector, central retinal thickness (CRT, SD-OCT), best-corrected visual acuity (BOVA) and dilated fundus examination were recorded in 375 eyes of 375 patients (169 male, 206 female, age 36-94 years). Metamorphopsia index is calculated by the program. Monocularly perceived distorted lines are straightened on a screen by using a mouse (adequate near correction).

Metamorphopsia index consists of 3 indices representing degree (v), localization (ex) and area (a). In monocular disease the pathological eye was included. In binocular normal or pathological cases the included eye was randomly chosen. Diagnoses were classified based on a diversified Beckman classification (Fig.1). Prior to the study all patients signed informed consent (declaration of Helsinki/Edinburgh resp.).

Correlation of Metamorphopsia sum index and central retinal thickness were explored. Sensitivity and specificity of AMD – A Metamorphopsia Detector was examined regarding two perspectives: clinical relevance, i.e. therapeutic consequences (recommendation for further diagnostic, intensified control or for therapy (laser or operation)) and morphology, i.e. SD-OCT confirmed anatomic findings respectively.

Results

I. Correlation AMD-Index and CRT

Metamorphopsia sum index and CRT showed a strong correlation:
- Age-related macular degeneration with edema:
  #1: Spearman's p: 0.65, p: 0.0002
  diabetic macular edema:
  #1: Spearman's p: 0.85, p: 0.004
- Edema due to myopia, uveitis, venous thrombosis, Irvine-Gass:
  #8, 9, 15, 19: Spearman's p: 0.73, p: 0.003

II. Sensitivity and Specificity

Perspective of clinical relevance

Regarding therapeutic recommendation for further diagnostic or for therapy AMD – A Metamorphopsia Detector had a sensitivity of 94.12% and a specificity of 97.27%.

Of all 375 eyes, 96.26% were correctly classified by AMD – A Metamorphopsia Detector (112 correct positive, 249 correct negative, Cohen's Kappa 0.92).

False negative test rate of AMD-index was 2.73% and 75% of these 7 eyes had diagnosis #3 (AREDS 3).

Perspective of morphology

Sensitivity of AMD – A Metamorphopsia Detector for OCT-confirmed anatomical findings regarding clinical relevance was 54.59%, specificity was 95.83%.

Of all 375 eyes, 74.07% were correctly classified by AMD – A Metamorphopsia Detector (Cohen's Kappa 0.5).

Discussion

The gap between clinical sensitivity (94.12%) and anatomical detection rate (54.59%) illustrates that a not-ideal OCT does not necessarily lead to clinical consequences: #2 (ARCMDS): 22%, #3 (intermediate): 29%, #5 (vitrectomy: 12%), 27%. False negative AMD-index with clinical perspective can partially be explained by perceptual completion ("filling in"). 7 of 54 (13%) AMD-index of #3 (AREDS 3) pointing out the importance of close-meshed controls in intermediate AMD. In groups #8, 9, 15, 19 and #4, 6, 11, 17, 21 metamorphopias were no longer observable in case of macular occlusion. This leads to a negative correlation index.

Contrary to qualitative tests with attribute data AMD – A Metamorphopsia Detector provides variable, operationalizable data, reflects visual impression precisely and can be implemented in multidimensional and case management systems of chronic diseases like diabetes of age related macular degeneration. In scenarios without fix treatment schedules (pro re nata) and after treatment cycles are terminated AMD – A Metamorphopsia Detector may play a role as an easy-to-use, cost-effective, interactive device with high sensitivity and specificity for clinically relevant findings that can be used as a clinical or home based test.

Conclusion

AMD – A Metamorphopsia Detector as an easy to use, cost-effective clinical or home based interactive device delivers valuable data reflecting a patient reported outcome with high clinical sensitivity and specificity and good correlation of AMD-index and CRT in executive AMD, DME and edema due to myopia, uveitis and thrombosis. AMD – A Metamorphopsia Detector has the potential – especially when implemented in screening programs, multidimensional and case management systems - to improve self efficiency, diagnostic and therapeutic compliance, adherence, effectiveness and quality in the monitoring and treatment of macular diseases.