Adaptive optics retinal imaging: Applications in retinal and systemic disease

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Outline

1. Introduction to adaptive optics
    a. What is adaptive optics and how does it work?
        i. Basic principles
            1. Wavefront sensor
            2. Deformable mirror
            3. Aberrations corrections
                a. Atmosphere
                b. Higher and lower order ocular aberrations
        ii. General applications
            1. Military
            2. Astronomy
            3. Vision Science
                a. Anterior segment
                b. Visual function
                c. Retinal imaging
                    i. Fundus camera
                        1. Commercialized and some clinical use
                    ii. Scanning laser ophthalmoscopy
                        1. Most common
                    iii. OCT
                        1. Advantage of improved axial resolution
                    iv. Retinal structures visualized with AOSLO
                        1. Nerve fiber bundles
                        2. Ganglion cells
                        3. Retinal vessels
                            a. Vascular wall structure
                            b. Individual red blood cells
                        4. Cones
                        5. Rods
                        6. Retinal pigmented epithelium (RPE)
                        7. Other
                    v. Functional measures
                        1. Blood flow
                            a. With and without flicker
                        2. Cone function

2. Adaptive optics in retinal disease
    a. Systemic vascular disease
        i. Diabetes
            1. Subclinical detection of diabetic retinopathy
            2. Retinopathy is worsened compared to clinical examination
            3. Better visualization and categorization of clinical lesions
                a. Microaneurysms
                b. Exudate
                c. Edema
                d. Etc.
            4. Blood flow alterations
            5. Cone alterations
                a. Dark Cones
        ii. Hypertension
            1. Wall-to-lumen ratios
                a. Increased
                b. Advantages over other techniques
            2. Cotton wool spots
    b. Glaucoma
        i. Lamina cribosa morphology
        ii. Vascular changes
        iii. Ganglion cell imaging
        iv. Trabecular meshwork imaging (AO gonioscopy)
    c. Retinal degenerations
        i. Numerous investigations
        ii. Clinical trials
    d. Other
3. Challenges with integration into clinical practice
    a. Small field size
    b. Length of imaging sessions
    c. Imaging processing
4. Summary