Introduction: We aimed to characterize early visual impairment of patients with ocular hypertension (HT), using psychophysical, electrophysiological and structural methods. We assessed the diagnostic accuracy of each test and compared their sensitivity for a fixed specificity. Furthermore, we compared the sensitivity of these methods with three novel psychophysical discrimination tests designed by our group. The ability of these methods to probe disease progression was also analyzed.

Methods: Visual function was assessed in a cohort of 52 participants recruited from the glaucoma consultation: 18 patients with ocular hypertension, 15 glaucoma suspects and 19 with primary open-angle glaucoma. Quantitative psychophysical methods were used to assess magno (Frequency Doubling Technology), parvo and koniocellular pathways (Cambridge Color Test), and RGC function was assessed by Pattern Electroretinogram. We also used three novel 2-alternative forced choice psychophysical discrimination tests (independent variables: motion, achromatic, and chromatic L, M, and S-cone contrasts) between 2 separated peripheral, small moving single dots at 4 distinct meridians. Ganglion cells axonal layer thickness was obtained using Optical Coherence Tomography (OCT). These patients were compared with an age-matched group of controls (n=20).

Results: An impairment in mean achromatic contrast sensitivity (p=0.0298) was found in patients with HT, as well as a reduced PERG N-95 wave amplitude (p=0.0499). Chromatic thresholds were significantly increased for protan, deutan and tritan axes (p<0.03) in these patients when compared with the control group. At approximately 80% specificity, FDT showed only moderate sensitivity to detect early functional damage (superior nasal quadrant, 66% sensitivity). Meanwhile, for the same comparison, the three novel psychophysical yielded sensitivities above 90% for fixed 80% specificity. The pattern of disease progression decline is approximately linear for all tests, but is more severe in OCT, namely RNFL thickness (r = 0.47).

Conclusion: We found a relative damage of magno, parvo and koniocellular retinocortical pathways since the initial stage of the disease. The sensitivity of currently available tests is lower comparing with our novel psychophysical discrimination tools (sensitivity above 90% for 80% specificity), suggesting that their smaller degree of test redundancy leads to a great ability to detect early glaucomatous damage. Finally, all these tests are potential markers of disease progression, since their measures correlate moderately with the ordered levels corresponding to natural course of glaucoma, especially in which concerns the structural test since its pattern of decline is more pronounced.