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Macular pigment measurements: which method should we use?

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Macular pigment (MP) was investigated as early as 1866, when Max Schultze concluded that there is a functional connection between the "yellow spot" in the retina and the absorption of blue light. He stated that MP may provide protection against the hazard of short-wavelength visible light. MP consists of the two hydroxycarotenoids lutein (L) and zeaxanthin (Z) and is of is of alimentary origin. Human MP is detectable in the whole retina, but the highest concentrations are found in the fovea [17]. As many antioxidative properties are attributed to the MP, it has been investigated in respect to its role in the pathophysiology of age-related macular degeneration (ARMD). The properties of MP include a high capacity to absorb short-wavelength blue light [19]. The peak of the MP absorbance spectrum is at 460 nm and works as a broad-band filter for the macula. Two advantages are achieved: (1) the macula's optical accuracy is improved [11, 16] and (2) the damaging photooxidative influence on the neurosensory retina is reduced. In the photoreceptor outer segments, the antioxidant effect of L and Z is the essential mechanism [1, 22]. The antioxidant properties enable the carotenoids to neutralize free radicals.

The optical and antioxidant properties of MP, its possible relation to the pathophysiology of ARMD, and the possibility to modify macular pigment optical density (MPOD) by nutritional supplementation have resulted in a growing interest in research on MP. This is reflected by a growing number of papers on MP during recent years.

MPOD can be measured by psychophysical and optical means. These include heterochromatic flicker photometry [12, 24] and minimum motion photometry [23], Raman spectrometry [8, 9, 14], imaging reflectometry [3, 13], reflectometry [4, 27], and autofluorescence spectrophotometry [12] and imaging [6, 23, 26]. This large number of different methods may explain the inconsistencies between papers on MPOD in patients with various stages of ARMD [1, 2, 5, 7, 10, 15, 16, 18, 19, 21, 24]. The current issue presents a paper in which Trieschmann et al. [25] present MPOD measurements using autofluorescence images. They compare a method [27] based on pioneering work from Delori et al. [12] using autofluorescence images obtained at two wavelengths (488 nm and 514 nm) by means of a method presented by the same group previously [23, 26] using autofluorescence images obtained at one wavelength (488 nm). They describe in great detail the theory of MPOD measurements using autofluorescence imaging, repeating previous work [12]. In their manuscript they conclude that the one-wavelength method is adequate for visualizing the MP but not for determining MPOD, whereas the two-wavelength method allows for accurate determination of

MPOD. These conclusions are mainly based on the theoretical considerations presented in the methods section. However, the actual measurements presented in the paper do not permit these conclusions. There is no evidence that one method is better than the other, since no comparison with an independent measure of MPOD based on a more established technique such as psychophysics is presented in the manuscript. However, recently a comparison between the two-wavelength method using autofluorescence imaging (AF) and the heterochromatic flicker photometry (HFP) technique has been published [20]. In this paper no correlation between the two methods was presented. However, the large difference in the coefficient of variation for repeated measurement between the two methods (16.6% for HFP vs 3.3% for AF) suggests that the two-wavelength AF method is more precise than the HFP method for determination of MPOD [20].

Recent work suggests that the distribution of MP could be more important than central MPOD [6, 18, 23]. Therefore, future studies on MP should use a method allowing measurement not only of MPOD in the foveal center but also of MP distribution. Since the determination of MP distribution with psychophysical methods is difficult and very time consuming, MPOD measurement by imaging methods appears to be more suitable for clinical studies. The theoretical considerations presented in the paper by Trieschmann et al. [25] suggest that we should abandon the one-wavelength AF method and use only the two-wavelength method for future studies.

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