Evaluation of macular pigment optical density(MPOD) with a color perimetry technique. Normal values and influence of diet

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Introduction:

In 2008 **Age-related Macular Degeneration** (AMD) involved 8 percent of the French population over 50 years and more than 25 percent over 75 years, ie 1,500 000 people. Theses figures should double in 30 years (Soubrane, 2008). At present, no treatment is efficient for most of this population.

The macular pigment (MP) is thought to have a protective role in age-related macular degeneration by reducing the oxidative stress on the retina (Cai, 2000) and reducing the deleterious effects of short-wave light (Taylor, 1989, Beatty, 2001).

The macular pigment density peaks at the foveal center (Snodderly, Bone, 1985).

The macular pigment is composed of xanthophylls, **lutein** and **zeaxanthin**, obtained in the diet (Seddon, 1994). Dietary intake of lutein and zeaxanthin, for most individuals, is related to retina concentrations of macular pigment (Nolan 2007) but absorption varies (Ciulla 2001, Nolan 2007) it decreases in smokers and overweight people (Hammond, 2002) in those L and Z fat-soluble nutrients, are carried first to fat cells.

Purpose:

Our purpose was to study the clinical applicability of a color perimetry technique (CPT) for the evaluation of the optical density of macular pigments and to establish normal values taking into account the diet of subjects.

Methods:

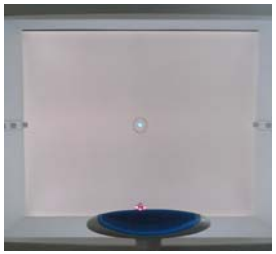
Luminance differential thresholds were measured for 2 stimuli: a blue stimulus (450-480 nm) absorbed by the MP, and a red one (615 nm) not absorbed. The stimuli were presented at the fovea and at 6 peripheral locations with an eccentricity of 3 to 10 degrees. Tests parameters were Goldmann size III over a white background of 10 $cd.m^{-2}$. Tests were presented on a TFT monitor calibrated according to the DICOM standard. A staircase 4-2-2-2 full thresholding strategy was used.

Exams were performed on **54 subjects** with normal visual acuity, normal eye fundus and no ophthalmic disease.

The subjects were interviewed about their **dietary habits** by a questionnaire written for this study according to a list of foods established by Pasteur Institute in Lille (Pr Lecerf) and classified into two groups:

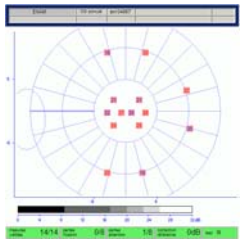
One with “recommended diet” consisting of more than 5 fruits and vegetables rich in L and Z and fat fish, omega 3 and no regular smoking.

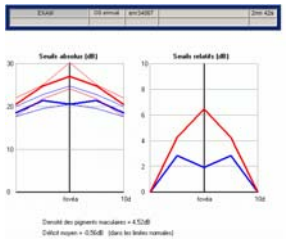
An other group with “poor diet”. They were also asked if they were smokers, or had relatives suffering from AMD and if they could or wanted to change their dietary habits if the examination found a low MPDO.



Results:

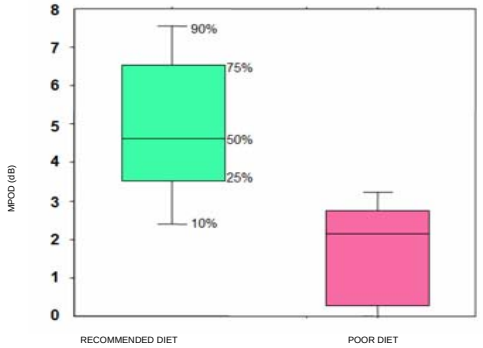
- The optical density of macular pigment (MPOD) was estimated as the difference between the thresholds of blue and red stimuli at the fovea. A correction for the blue absorption by the lens was made based on the difference between the thresholds of blue and red stimuli at 10 degrees eccentricity. The average value of the tested population was 3.49 db (0.349 log units) with a standard deviation of 0.2 log units.





- Influence of diet:

The following figure shows the distribution of the results from the two groups. The group with a “recommended diet” has a significantly higher MPOD (average value = 0.506 log units, standard deviation = 0.19) than the group with a “poor diet” (average value = 0.230 log units, standard deviation = 0.15). The difference between the 2 populations was is highly significant ($p < 0.0001$).



Discussion :

Estimation of MPOD:

The estimated values for MPOD found with CPT are within the range of values previously reported with other techniques:

- heterochromatic flicker photometry: 0.43 log units (SD 0.20) (Hammond, 2005),
- fundus autofluorescence: 0.28 log units (SD 0.10) (Hammond, 2005),
- fundus reflectometry: 0.60 log units (SD 0.20) (Van der Veen, 2009).

However, these studies showed a large inter-individual variability and did not take into account the diet of subjects.

Influence of diet:

The estimated values for MPOD are significantly affected by the diet. This is in agreement with the results of previous studies

Conclusions:

The color perimetry technique provides an estimation of the optical density of the macular pigment quite similar to values found with other techniques. It can be used on a standard visual perimetry equipment with natural pupil.

Our results show a significant effect of the dietary habits. Therefore, dietary information should be taken into account for the establishment of reference data.

Even if it is not yet established that macular pigment density is a risk factor for ARMD, these results suggest that the measurement of macular pigment density may be used to support dietary recommendations and / or the prescription of nutritional supplements.

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