Optical instruments

Lecture 5
Dark adaptation

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Dark adaptation

Dark adaptation: is the evolution of the retina from the light-adapted (photopic) to the dark-adapted (scotopic) state,, then the sensitivity had increased 35 dark adaptation refers to how the eye recovers its sensitivity in the dark following exposure to bright lights time after time in the dark.

Maximal sensitivity is reached after 30 minutes or more in the darkness, depending on the species and light level before adaptation began.

Dark adaptometry

A type of electro-physiologic retinal testing done to diagnose and manage retinal degeneration by measuring the length of time it takes for the retina to regain maximal sensitivity to low amounts of light after it has been exposed to bright light then returned to darkness.

Dark adaptometry may be a useful diagnostic test and clinical trial endpoint for age-related maculopathy (ARM) because impaired night vision is a hallmark of early ARM.

ARM also known as age-related macular degeneration, affects approximately 30 million people worldwide

Goldmann-Weekers adaptometer

This photometric precision instrument is so constructed that the examiner can record the logarithm of the light threshold for a given time of dark adaptation directly on semi-logarithm paper attached to a drum effecting one rotation per hour. Dark adaptation curves of different normal individuals are never identical and sometimes vary considerably. In order to make a diagnosis of pathological dark adaptation, it is necessary to obtain data obtained under standard conditions to define the range of the physiological variation.

Cont.

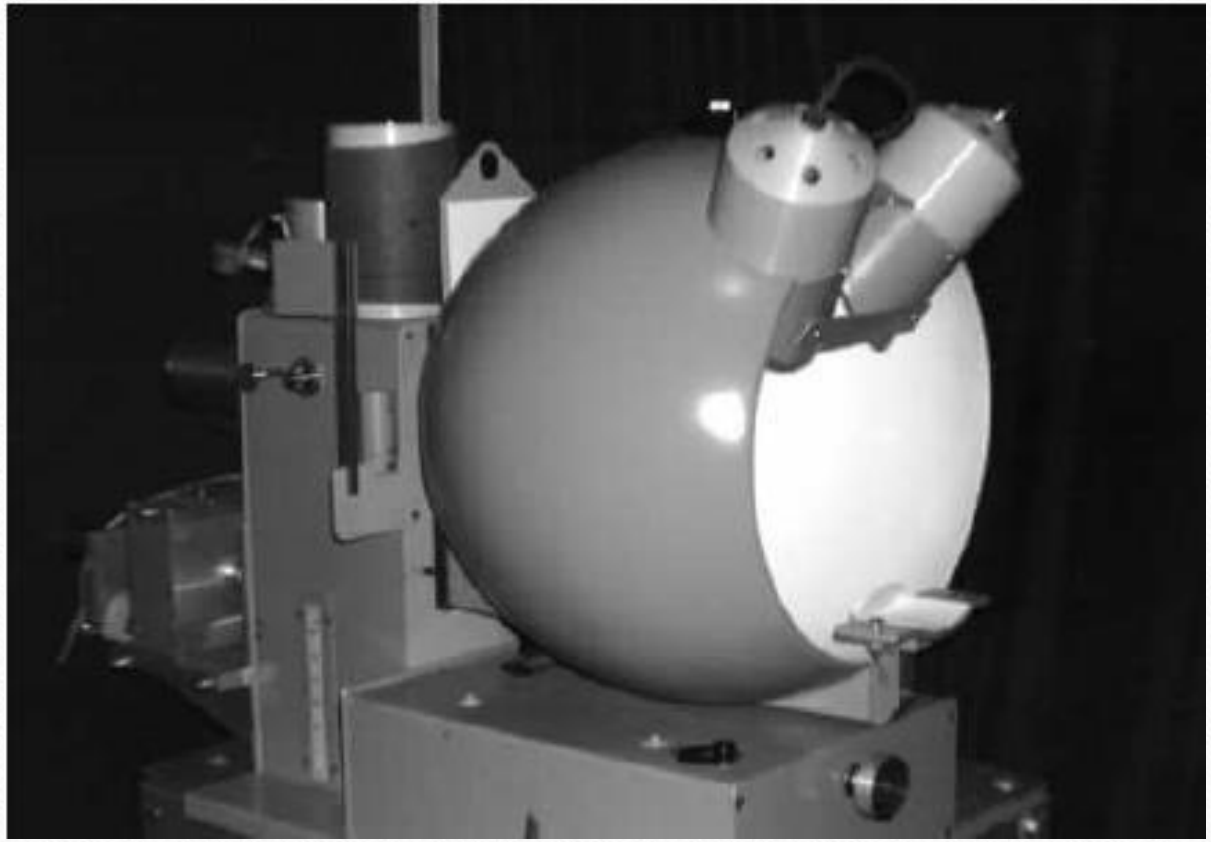
The object of this paper is

- to determine a standard curve (mean curve)
- the physiological limits of dark adaptation

How to test

After a brief preadaptation period, the subject looks into the center of a white sphere. A bright light (bleaching light), is projected in this apparatus to cause depletion of the photo-pigments, making the retina less sensitive to light.

Next, during dark adaptation, a circular stimulus field with 11 degrees of arc is presented centrally at a distance of 30 cm



Technique

(1) The pupil is fixed in dilatation

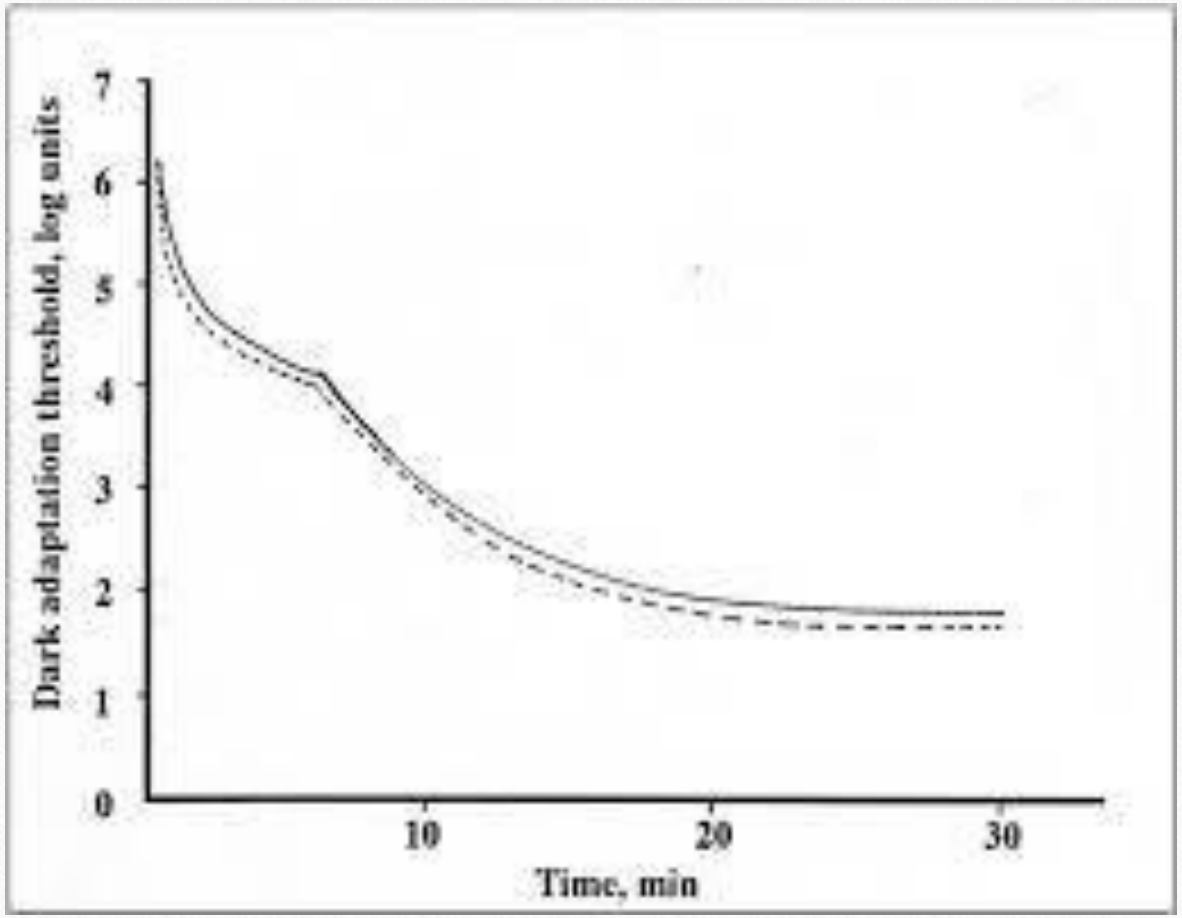
(2) The examination is monocular;

(3) 15 minutes of dark adaptation is given before pre-adaptation to light;

(4) 5 minutes (±15 seconds) of pre-adaptation to light is given. The brightness of the adapting field is 1,400 (white light)

Cont.

(5) The threshold is determined at intervals of approximately 1 minute during dark adaptation (for 45 minutes). The test field used in the determination of the threshold is a 120 striped opal glass disk. The stripes are black and white, with 100 per cent. contrast. The brightness of the white stripes can be varied
The threshold is determined by increasing the brightness of the test field until the subject perceives the black and white stripes;
(6) There is no fixation point (the eye is free to look for the test field).


Dark adaptation threshold, log units
7
6
5
4
3
2
1
0
10
20
30
Time, min

Cones- Rods mechanism

Dark adaptation forms the basis of the Duplicity Theory which states that above a certain luminance level (about 0.03 cd/m2), the cone mechanism is involved in mediating vision; photopic vision. Below this level, the rod mechanism comes into play providing scotopic (night) vision.

The range where two mechanisms are working together is called the (mesopic) range, as there is not an abrupt transition between the two mechanism.

The sensitivity curve

First section (cone):

- Rapid threshold reduction (5 min)
- This represents the cone thresholds

Rod- cone break :

- break in curves that occur after 7-19 min of adaptation, is when rod becomes more sensitive to light

Second section

- Reduction in threshold that extends to 35 min
- This represents the rod thresholds

Rod -Cone break

When stimuli of different wavelengths are used, the dark adaptation curve is affected, a rod-cone break is not seen when using light of long wavelengths such as extreme red. This occurs due to rods and cones having similar sensitivities to light of long wavelengths depicts the photopic and scotopic spectral sensitivity functions to illustrate the point that the rod and cone sensitivity difference is dependent upon test wavelength. On the other hand, when light of short wavelength is used, the rod-cone break is most prominent as the rods are much more sensitive than the cones to short wavelengths once the rods have dark adapted.