Short Communication

A NEWLY DEVELOPED DEVICE TO MEASURE OBJECTIVE AMPLITUDE OF ACCOMMODATION AND PUPILLARY RESPONSE IN BOTH BINOCULAR AND NATURAL VIEWING CONDITIONS

Key words: accommodation; pupil size; VDT; binocular vision; accommodo-refractometer

In 1956, Campbell and Robson developed a high resolution optometer which made it possible to measure changes in refractory power objectively using reflected light from the fundus of the eye. It was a revolutionary development, but there were limitations, as, for example, the subject had to see the target monocularly through a hole of an instrument. In the present study, we attempted to measure the accommodation and pupillary response with a newly developed device as a means to measure these factors in both binocular and natural viewing conditions. We compared the results with the values of the subjective amplitude of accommodation obtained from the near point distance.

Methods. Figure 1 shows the newly developed measuring system. (1) The changes in accommodation are measured and recorded in terms of target translation. (2) Changes in pupil size are measured and recorded. (3) The system developed for the present experiments was devised in order to measure accommodation and pupillary response under binocular and natural viewing conditions. A schematic diagram is shown in Fig. 2. The motor can move the target vertically at a speed equivalent to 0.5 cm per s, and the target is made visible to both eyes through a half-mirror.

Twenty-seven subjects of various ages were chosen for the study and the following measurements were carried out: (1) measurement of the changes in accommodation occurring with movement of the target under binocular and natural viewing conditions and (2) measurement of the changes in pupil size as a means to evaluate the pupillary response and measurement of near point distance under the same conditions.

Results and discussion. Figure 3 is an example of one subject [32 yr, male; myopia (−1D); subjective near point=14 cm; subjective amplitude of accommodation=6.1 D]. The changes in accommodation occurring with movement of the target in close are clearly recorded. Figure 4 gives the changes in pupil size accompanying the target movement. As the target draws near, the size of the pupil contracts, reflecting the contraction accommodation process. The changes in pupil size are small with aging and the depth of focus due to the fact that the pupil size compensates...
obtained by the near point distance measurement of Ishihara.  

Sun and Stark have reported that accommodation amplitude decreases with aging using an objective accommodometer monocularly. Middle-aged and elderly persons using VDTs need glasses appropriate for VDT work in order to prevent visual fatigue, since their accommodation amplitude tends to decrease. This newly developed device is expected to enable more effective and objective evaluation of visual conditions.

References


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Fig. 4. Changes in pupil size under binocular and natural viewing.

Fig. 5. Changes in accommodation amplitude with age under binocular and natural viewing.

for the decrease of accommodation amplitude. The accommodative amplitude is calculated from the results, and scattergrams are drawn according to the relation between age and accommodation power. Figure 5 presents the case for binocular and natural viewing conditions. The accommodative amplitude decreases with aging, and with binocular and natural viewing it has a value quite close to the subjective accommodation power.