Chapter 9

Kinetic Visual Field with Changing Contrast and Brightness

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ABSTRACT

Dynamic perimetry is the area in which a subject is able to recognize a moving target by eye. It is used in medical tests to diagnose glaucoma and cataracts. Evaluation of the kinetic visual field involves the use of an isopter. In a previous study, the area of the kinetic visual field was shown to become smaller with decreased target brightness and advancing age (Hashimoto, 2003). Moreover, the fields in the left and right eyes are the same. It is also known that dementia patients experience symptoms that lower their ability to recognize objects under conditions of weak contrast between the target object and the background (Trick, Trick, Morris, & Wolf, 1995). However, the exact relationship between this contrast and their visual fields is unknown. In this study, the areas of kinetic visual field were measured quantitatively on normal people as a fundamental study of the early detection of dementia in patients. These results were reported using an improved Goldmann perimeter, which has an electric slider to operate targets at constant speeds.

INTRODUCTION

Alzheimer’s disease is a chronic, progressive, neurodegenerative disease that is characterized by clinical symptoms and pathological changes that are mainly characterized by signature disorders (senile plaques, nervous system fibril changes or nervous system cell death). With the progression of Alzheimer’s disease, in addition to these signature disorders, cognitive functional disorders arise,
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including impairments in language faculty and visual space recognition. If Alzheimer’s disease is detected early, the patient has the possibility of recovery through medical therapy and rehabilitation. However, with advancing disease, recovery becomes nearly impossible because the dead nerve cells caused by the disease cannot be restored (Kawakami & Fukushima, 2002). Therefore, regular checkups are very important for at-risk individuals to diagnose the disease early. Because cognitive function impairment in the initial stages of Alzheimer’s disease is extremely slight and difficult to diagnose clinically, there is a limit to the symptoms that can be detected in early checkups. Thus, the development of a diagnosis that enables early disease detection is necessary. In this study, the decrease in contrast sensitivity and field of vision impairment (Andrew, 2004) that are known to occur in Alzheimer’s patients were considered as possible early diagnosis tools. Specifically, we used the Goldman perimeter in this study; in this technique, the dynamic perimetry was measured with changing contrast and brightness (Figure 1) on ten people with normal sight abilities.

STATIC AND KINETIC VISUAL FIELDS

A. Static Visual Field

The static visual field is defined as the area in which targets do not move in static perimetry experiments. Measurement points were set to measure visual fields. The brightness of the measurement points was changed from dark to bright, and sensitivity thresholds were determined. Therefore, by determining the sensitivity thresholds at each measurement point, visual fields were evaluated. The normal extent of the static visual field for a bright stimulus is 60 degrees up, 75 degrees down, 100 degrees temporally and 60 degrees nasally. Figure 2 illustrates this extent of visual field. It is difficult for both disabled and normal people to recognize targets and focus on fixed points continuously in the experiment in whole area. However, it is known that the central visual field in 30 degrees tends to have a trouble during the first stage of glaucoma (Hashimoto, 2003; David, 1993). Thus, static perimetry is well suited for glaucoma diagnosis.

B. Kinetic Visual Field

Dynamic perimetry is defined as the way in which a subject finds a target that moves from outside the visual field to inside the visual field. The kinetic visual field is measured to determine the range in which the target can be seen. The range is shown by a curve known as an isopter (Figure 3). Abnormal characteristics of the visual field were inspected from the area and shape of the isopter. In a previous study involving a normal person, the area of the kinetic visual field becomes smaller with increasing target brightness and advancing age. Moreover, the fields in the left and right eyes are the same.

VISUAL FIELD AND ALZHEIMER’S DISEASE

Trick et al. performed automated perimetry (Humphrey) on 61 patients with AD and 61 age-matched controls. Differential luminance sensitivity was decreased (especially in the inferonasal and inferotemporal arcuate regions) in the AD group.