Development and Clinical Evaluation of an Eye Movement Input Device Designed to Assist Continuous Communication in Amyotrophic Lateral Sclerosis Patients

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Abstract

We developed an eye movement input device that could continually be used by a simple input in amyotrophic lateral sclerosis (ALS) patients. The device configuration consisted of a head unit weighing 85 g with a mounted video camera, and an eye movement detector device with a circuit for detecting eye movement on a small liquid crystal monitor. The function of the developed eye movement input device was to enable, by movement of the eyes, a 1-channel contact signal output to a communication support device or computer, and ringing of a bell. Users could operate this without looking at the main unit device monitor. Operation status was confirmed by the communication support device screen or input sound, or the chiming sound of a bell. Between 2004 and 2007, the eye movement input device was clinically evaluated in 4 ALS patients. The 4 patients included 2 men and 2 women, 3 aged 50-59 and 1 aged 70-79. The period of use was as follows: 33 months in patient 1, 2 months in patient 2, 1 month in patient 3, and less than 1 week in patient 4. The clinical evaluation results and a discussion of patient 1 (woman, aged 50’s) are described in detail. The device was designed so she could input commands to a personal computer and bell output. The device assisted her communication included daily requests to a caregiver for body repositioning or suction of saliva and conversations with nearby persons. Periodically, responses to physician inquiries helped to determine caregiver and treatment planning. The present results showed that the current eye movement input device effectively assisted continuous communication in ALS patients.

Keywords: Amyotrophic lateral sclerosis (ALS), Communication, Eye movement, Input device

1. Introduction

Amyotrophic lateral sclerosis (ALS) is a disease in which motor neurons degenerate, causing progressive deterioration of voluntary motor function [1]. Its incidence is 2 to 5 cases per 100,000 people, and there is presently no effective cure. In ALS, as voluntary motor function progressively decreases [2], means of communication become limited. Guidelines by the Societas Neurologica Japonica [3] recommend that communication support, such as operation of a personal computer, be started early.

To assist communication, communication support devices that assist in the operation of bells and personal computers, and input devices, are being introduced. To efficiently operate these communication support devices, it is important that input devices meet the needs of users in terms of their voluntary motor function. In ALS patients, even if input devices that are compatible with voluntary motor function are introduced, as the disease progresses, these devices often can no longer be used [4]. Thus, changes in input devices are necessary as the motor function decreases. However, every time an input device is changed, not only does the patient have to learn how to use the new device, but their caregivers also have to learn how to install it.

In Japan, ALS patients with a confirmed diagnosis are eligible to receive communication support devices and input devices [5]. When an input device can no longer be used due to disease progression, an application can be made so that the patient can receive a new input device. However, as the time from application until receipt can be as long as 1 month, this means the patient will temporarily lose the ability to communicate via an input device during this period. Therefore, changing a communication support device can become a major hindrance to maintaining continuous communication in ALS patients.

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