Image Analysis of a Cerebral Function Clarifying to Restructure the Rehabilitation Medicine

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In recent years, rapid aging has become an important problem in many countries. With the aging of society, the number of stroke patients has increased year by year. Many stroke patients require rehabilitation in order to resume normal life. Although one physical therapist (PT) manages one patient in conventional rehabilitation, this system cannot be used to handle the rapidly increasing number of patients. Therefore, we proposed a system in which one PT manages many patients using certain devices, the so-called motivative exercise (Takizawa method). Motivative exercise is better suited as a rehabilitation system for the future. However, this system is currently unacceptable in Japan and other countries. One reason for the unpopularity of this system is a misinterpretation of motivative exercise: it is thought that many PTs will lose job opportunities because of this system. We believe that this misunderstanding results from misinterpretation of the business model of the Takizawa system.

During the stages of diagnosis and treatment in a general hospital, one doctor examines a large number of patients, and the hospital gains considerable income from the patients. However, in the current rehabilitation system, each hospital gains scanty income from patients, because one PT manages one stroke patient for a certain length of time. Therefore, in the current system, an economically disadvantaged hospital cannot hire more PTs. Since one PT manages many patients in motivative exercise, one PT can gain much higher income for the hospital; thus, the hospital can hire more PTs. We believe that a small hospital can hire a few PTs; therefore, motivative exercise would produce jobs for many PTs. We think that the current rehabilitation system would be rejuvenated by motivative exercise.

Although motivative exercise with devices is an advantageous business model for hospital management, we must show the availability of motivative exercise by rehabilitative efficacy, objectively with the rehabilitation score and brain function measurement. A traditional method for measuring rehabilitative efficacy is the rehabilitation score prepared by a PT; recent methods include brain function measurement by functional magnetic resonance imaging (fMRI) and near infrared spectroscopy (NIRS) with computer analysis. Currently, our team evaluates the efficacy of motivative exercise on the basis of the rehabilitation score and brain function measurement. Our research laboratory uses brain function measurement for the evaluation.

For measurement of the inner structure of the brain, fMRI examination is better than NIRS examination because of its superior resolution. However, fMRI examination cannot be performed when using some devices, since the patient may not move during examination and may not use some metal objects near the fMRI scanner. Therefore, NIRS is a better examination for evaluating the efficacy of rehabilitation. An NIRS image has lower resolution than that of an fMRI image, and only near-surface information is obtained through NIRS. We evaluated depth information of affected area on an NIRS image using approach of inverse problem in engineering, and measured the rehabilitative efficacy from the viewpoint of brain function recovery. Once the efficacy of the Takizawa method is proved on the basis of the rehabilitation score and brain function measurement, the Takizawa rehabilitation system will be widely used.

We hope that new researchers participate in our approach of providing important innovations in the field of the rehabilitation, through a workshop and research exchange in the 11th IBRC.