Relationship between Probe Reaction Time of Physical Therapists and their Patient’s Accidents

MING HUO1), HITOSHI MARUYAMA1), HUI LIN LIU2)

1)Department of Physical Therapy, Faculty of Heath Science, International University of Health and Welfare: 2600–1 Kitakanemaru, Ohtawara City, Tochigi 324-8501, Japan.
TEL +81 287-24-3000, E-mail: huoming@iuhw.ac.jp
2)China Rehabilitation Research Center

Abstract. The purpose of this research was to investigate the relationship between the probe reaction time of physical therapists and their record of patient accidents involving falling. The measurement items were the simple reaction time, the probe reaction time, and the Trail Marking Test Part-A. The probe reaction time was measured while the subjects were walking at a self-determined velocity. The subjects were divided into two groups: 11 physical therapists who had experienced patient fall accidents at least once in the previous 12 months (Fall group: 9 males, 2 females); and 26 physical therapists with no history of patient fall accidents (No-fall group: 14 males, 12 females). Using a digital audio player (for sonic stimulation) and sound recording equipment, the probe reaction time was measured. The results show that the probe reaction time of the Fall group was slower than that of the No-fall group. The simple reaction time and Trail Marking Test Part-A were not significant different between the Fall and No-fall groups. In logistic regression analysis with fall accident as the dependent variable, only the probe reaction time was significant. The cut-off value of the probe reaction time was 328 ms by evaluation of receiver-operating-characteristic curve. It was found that the probe reaction time of physical therapists is reliable and useful for predicting the falling accident risk.

Key words: Probe reaction time, Physical therapists, Falling accident

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INTRODUCTION

Many falls suddenly happen in daily activities, and falls are a serious social issue now. For the physical therapist, physical therapy for injuries received in falls has become commonplace in practice.

In previous studies concerning fall, there are many assessments of physical functions, but very few studies have directly examined the cognitive functions. Several studies have used the simple reaction time and the choice reaction time as indicators of the cognitive functions to examine the falls. However these studies have some flaws, the participation rate was low or expensive equipments was used1, 2).

Reaction time is thought to influence the balance ability. One of the factors of falls is the long reaction time. It is thought in neurology that there is a limitation in the capacity of processing information from the environment. When a movement task is taking place, and another task is concurrently demanded, work is simultaneously required for the two tasks and this situation is known as a dual task. If the main task is comparatively simple, a comparatively large
amount of attention can be allocated to the second task. This makes it possible to perform the second task comparatively quickly, and it is interpreted that a lot of attention resources were allocated to the second task. So, if a second task (simple reaction time) is demanded during movement task enforcement and the reaction time to the dual task is relatively short, it implies that the main task is being performed automatically. This study method is called the probe reaction time. This method is recommended in movement-related research when trying to identify the attention required for performing the main task. Measuring phonatory reaction time is particularly recommended as in the above method it sensitively recognizes a slight change in attention demand in voluntary movement3).

Stroke patients have a high risk of falls in hospital. Stroke patients’ falls occur 2.2 times more often than in other patients4). They have problems with physical functions and cognitive functions of which are factors of falls. On the other hand, fall accidents often occur due to the inattention of medical treatment staff. In one of our previous studies, it was found that the probe reaction time is a reliable and useful evaluation of the risk of falls in the elderly5). In this study, we changed our attention to physical therapists; we examined attention factors, and discuss the relationship between the probe reaction time of physical therapists and the occurrence of their accidents.

METHODS AND SUBJECTS

The subjects were 37 physical therapists (31.5 ± 9.4 years; 23 males, 14 females) at a rehabilitation center in China. The subjects’ characteristics are detailed in Table 1. All the subjects gave their informed consent to participate in the study. The subjects were divided into two groups: a Fall group which included those who had experience at least one fall accident in the previous 12 months during physical therapy treatment; and a No-fall group with no history of fall accidents. The falls accident rate was 29.7%, the injuries sustained in falls were one fracture and slight injuries such as whips.

The Trail-Marking Test Part-A (TMT-A) was performed to indicate overall attention ability5). The simple reaction time was measured continuously 10 times in total when standing on the floor. To measure of the probe reaction time, the subjects were asked to walk at a self-determined velocity on a floor. The task was to measure the simple phonatory reaction time to an auditory stimulation.

A digital audio player/recorder (Rio·Japan) was used as an auditory stimulator. The recording device used a digital audio player/recorder (Rio·Japan), too. The auditory stimulation file was prepared on a computer as a preparatory activity. A file was edited as a random series of 16 warning signal - auditory stimulus signal sets (50 ms) by using personal computer sound processing software of DigionSound5 (Digion). The file was input to a digital audio player/recorder, and the digital audio player/recorder was connected to a portable speaker, so as to form an auditory cue box. The interval between the warning signals and the audio stimulus signal was completely randomized between 2–5 seconds.

An auditory cue box was attached to the abdominal region of the subjects to measure the probe reaction time. The subjects were required to respond to an auditory cue by loudly saying “Pah” as quickly as possible.

The sound “Pah” was recorded with a digital audio player/recorder hung on the subjects’ chest from the neck. It was measured ten times, and the average value was assumed to be the representative value. Prior to the experiment, the subjects were informed what would be done in the experiment, and they made trial exercises to familiarize themselves with the procedure. In the actual experiment, subjects were asked to walk at a self-determined velocity on flat lane. The reaction time was measured as the time from the issue of the audio stimulus signal to the utterance of “Pah”. One minute after the subject started walking, the probe reaction time cue box was activated and the probe reaction time was measured continuously for 10 times in total at the self-determined walking

<table>
<thead>
<tr>
<th>Table 1. Subject characteristics</th>
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<tr>
<td>No-fall group</td>
</tr>
<tr>
<td>(n=26)</td>
</tr>
<tr>
<td>Age (y)</td>
</tr>
<tr>
<td>Weight (kg)</td>
</tr>
<tr>
<td>Height (cm)</td>
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<td>Years of PT experience</td>
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Mean ± SD.
velocity. Data was input into a personal computer, and the DigionSound5 sound-processing software was used for the analysis.

To determine whether there was a difference between the No-fall group and the Fall group, the independent t-test was performed for each measure. Logistic regression analysis and the receiver-operating-characteristic (ROC) curve were used for the accrual of fall accidents and its relation to each factor. The Hosmer & Lemeshow Test judged the adaptability of the logistic regression analysis. The data were analyzed using SPSS Ver. 12.0 for Windows.

RESULTS

Table 2 shows that the probe reaction time of the Fall group was significantly longer than that of the No-fall group (p<0.05).

Logistic regression analysis with fall accidents as the dependent variable of the probe reaction time and the TMT-A was performed. To prevent multicolinearity, we excluded the factor of the simple reaction time. Two factors were selected as relevant; the probe reaction time and the TMT-A. The odds ratio was calculated and only that for the probe reaction time was significant, showing it is an independent factor of fall risk (Table 3). With falls accidents as the variable, the ROC curve of probe reaction time was calculated (Fig. 1). The area under the curve was 69% in the ROC curve. The cut-off value was 328 ms from assessment of the ROC curve, the sensitivity was 82%, and the specificity was 50% according to the intersection with the cut-off value.

DISCUSSION

The results for the Fall group show that their response time was slower than that of the No-fall group. It is thought that the prolongation of the
probe reaction time was caused by the amount of attention demanded for walking. There was no difference in the simple reaction time and TMT-A in between the groups. Thus, ability to pay attention to a single task was not diminished but ability to pay attention to the dual task was diminished. In logistic regression analysis, the probe reaction time and the TMT-A were determined as relevant, but only the probe reaction time was significant. It was thus found that probe reaction time as a dual task is useful for the evaluation of the risk of fall accidents.

One example of the dual task attention deficit can be considered as halting at the initiation of conversation during walking. Olsson6) defined that a dual task impediment is “Stop walking when talking”, and he clarified its relationship with the occurrence of falls. The sensitivity of Olsson’s test is as low as 48%, but the specificity is as high as 95%. “Stop walking when talking” is useful from the viewpoint of not overlooking the subject’s possibility of falling. However, the “Stop walking when talking” test has not been quantified yet. In the present research, the cut-off value of the probe reaction time was 328 ms from the assessment of the ROC curve, its sensitivity was 82%, and its specificity was 50%. We have shown that the detectability of the risk of a fall accident is high, and that the quantitative assessment of the risk of a fall accident is possible by using the measurement of the probe reaction time of the physical therapist.

The probe reaction time of physical therapists when walking was longer in the Fall group. Dual task ability was decreased in the Fall group. Thus, we consider physical therapists in the Fall group had lower ability of the patient falls during physical therapy exercises. This suggests that physical therapists in Fall group ought to pay more attention to patient falls during physical therapy. Furthermore, we think that training with dual tasks might be at improving the ability of physical therapists in performing dual tasks.

REFERENCES