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A Questionnaire-Based Survey: Therapist's Response towards the Upper Limb Disorder Learning Tool

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***Abstract*—**Previous studies have shown that there are arguments regarding the reliability and validity of the Ashworth and Modified Ashworth Scale towards evaluating patients diagnosed with upper limb disorders. These evaluations depended on the raters' experiences. This initiated us to develop an upper limb disorder part-task trainer that is able to simulate consistent upper limb disorders, such as spasticity and rigidity signs, based on the Modified Ashworth Scale to improve the variability occurring between raters and intra-raters themselves. By providing consistent signs, novice therapists would be able to increase training frequency and exposure towards various levels of signs. A total of 22 physiotherapists and occupational therapists participated in the study. The majority of the therapists agreed that with current therapy education, they still face problems with inter-raters and intra-raters variability (strongly agree 54%; n = 12/22, agree 27%; n = 6/22) in evaluating patients' conditions. The therapists strongly agreed (72%; n = 16/22) that therapy trainees needed to increase their frequency of training; therefore believe that our initiative to develop an upper limb disorder training tool will help in improving the clinical education field (strongly agree and agree 63%; n = 14/22).

***Keywords*—**Upper limb disorders, Clinical education tool, Inter/intra-raters variability, Spasticity, Modified Ashworth Scale.

I. Introduction

THE Modified Ashworth Scale (MAS) and the Tardieu Scale are routinely used in evaluating upper limb spasticity. Clinicians and therapists judge the severity of upper limb spasticity based on resistance from the patient's upper limb, by instructing the patient to relax and support the elbow, and subsequently move the patient's upper limb at different velocities. MAS is easily used in clinical practice, because raters require no equipment to rate their patients. The scoring method (as described in Table I) requires raters to interpret terms depending on their experience [1]. Reliability is a disadvantage, because no standardization exists for the number of repetitions, testing time (morning/afternoon), test position [2], etc. Other factors that contribute to the inter-raters and intra-raters variability include the fluctuation forearm extension speed for spasticity raters [3]. Despite the limitations of the MAS assessment method, it is still widely used for evaluation in clinical and education settings.

As a solution, a robotics system, with the ability to simulate patients' signs has been developed as a training tool for rehabilitation and clinician training [4] [5]. However, there is paucity in the implementations' of this training tool, as to whether it will be accepted in the clinical field and rehabilitation education centres, and how to apply the training tool into education modules.

TABLE I
Modified Ashworth Scale description [1]

MAS Score	Descriptions
0	No increase in muscle tone
1	Slight increase in muscle tone, manifested by a catch and release, or by minimal resistance at the end of the range of motion when the affected part is moved in flexion or extension
1+	Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the Range Of Movement (ROM)
2	More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
3	Considerable increase in muscle tone, passive movement difficult
4	Affected part(s) rigid in flexion and extension

This paper presents the responses of therapists regarding current therapy education and the implementation of the part-task trainer developed for the upper limb disorder. Therapists were asked, through a questionnaire-based survey, whether they agree or disagree with several statements regarding current therapy education, considering patients' safety during clinical training and the reliability of raters using current methods to evaluate patients with upper limb disorders.

II. Study Design

A set of questionnaires, as shown in Table II, was randomly distributed to physiotherapists and occupational therapists. The survey, which was conducted in Japanese and English, consisted of eleven questions (eight of which addressed objective assessment) with multiple-responses between *strongly disagree - disagree - agree - strongly agree* with the statement given. Three questions were subjective, including

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extended-response questions and suggestions from previous statements given in the questionnaire.

TABLE II
LIST OF QUESTIONS PROVIDED IN THE QUESTIONNAIRE

No.	Questions
Section A: Current Therapy Education	
1	Current education of physiotherapists and occupational therapist's training apply low fidelity mannequins, and role-play training between students or faculty physicians and simulated patients. Current training methods (might differ in different countries) are sufficient before students engage with real patients during their clinical training.
2	Using a method of low fidelity mannequins, and role-play training between students or faculty physicians and simulated patients, the students risk their patients' safety during their clinical training.
3	Despite using current methods, such as low fidelity mannequins, and role-play training between students or faculty physicians and simulated patients, we still have variable ratings of patients' symptoms severity between the therapist and the therapist himself/herself.
4	Students require a higher frequency of training before engaging with real patients during their clinical training.
Section B: Training Simulator	
5	Based on the explanation above, the suggested education method and the part-task trainer application can be implemented into physiotherapist and occupational therapist training.
6	I am interested in applying the suggested education method and part-task trainer within my department/university.
7	Comment on the answer given in Question 6.
8	With the implementation of a part-task trainer, the new training method could provide a higher frequency of training for students.
9	With the implementation of the suggested educational method and the application of the part-task trainer into the physiotherapist and occupational therapist's training, we can increase patient safety during clinical training.
10	With the implementation of the suggested educational method and the application of the part-task trainer, we can increase therapist's rating ability and reduce rating variability.
11	Suggestions towards improvement of the training simulator described in the questionnaire.

The questionnaire was divided into two sections, namely Section A: Current Therapy Education and Section B: Training Simulator. The questions in Section B concerned the part-task trainer that was developed in our laboratory [6]. Details of this device are summarized below as follows:

"In Shibaura Institute of Technology, Japan, we are developing a part-task trainer for the education purpose of physiotherapist and occupational therapist students (see Figs. 1 and 2). The simulator focuses on the upper limb disorder. The simulator is able to consistently reproduce the signs of spasticity and rigidity, such as the movement and resistance experienced by patients. By repeatedly simulating different levels of severity, this might improve the student's learning in rating the patient's level of spasticity, based on the Modified Ashworth Scale, and suggest a proper treatment schedule. We also hope that this will reduce the variability of ratings between raters and within raters. Current progress; the part-task trainer is still not able to reproduce muscle and anatomy movement. Apart from improving the therapist's rating ability; the application of a simulator may avoid the risk of patient injury and pain during clinical training. A new educational method, including the application of the part-task trainer, has been suggested to increase the therapists' capability. The conventional learning of surface anatomy and muscle testing from the role-play training between students or faculty physicians or simulated patients should continue; depending on your current institution's methods. Next, the student can increase the frequency of training and engage with various symptoms and levels of severity using the part-task trainer. They can learn communication skills, and manners and ethics through clinical training with healthy old people; before having clinical training with the real patients."

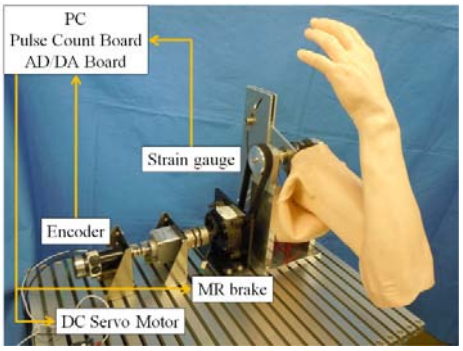


Fig. 1 Image of the part-task trainer for upper limb disorders under development



Fig. 2 Illustration of how to use the upper limb part-task trainer

III. FUNCTIONS OF THE PART-TASK TRAINER

For the part-task trainer's development, functions of the device are displayed in a function tree (see Fig. 3). The main function is defined as the ability to emulate stiffness symptoms, which requires angle detection and a calculation of the angular velocity, because this data is needed to control the torque displayed as stiffness [7]. The part-task trainer will replace the patient; therefore, it must be able to replicate the dynamics of arm motion, such as the flexion-extension, pronation-supination, and others. In order to avoid incongruity, the part-task trainer should have a good outlook and provide softness of touch (similar to that of a human arm). A thin silicone arm cover is used to wrap the part-task trainer.

The part-task trainer system is built with a set of DC servo motors and a Magneto-Rheological (MR) brake; to reproduce a stiffness that is similar to that of upper limb disorder patients. Depending on the angle recorded by the encoder at the elbow joint, the main actuator, the MR brake will continuously provide resistance towards the user. However, depending on the symptoms, the DC servo motor will be activated to generate the phenomenon of muscle reducing its stiffness. This is because the MR brake is not able to reduce the fluid particle

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settling rate to the required value in a short time. Therefore, the DC servo motor is used to support the delayed time.

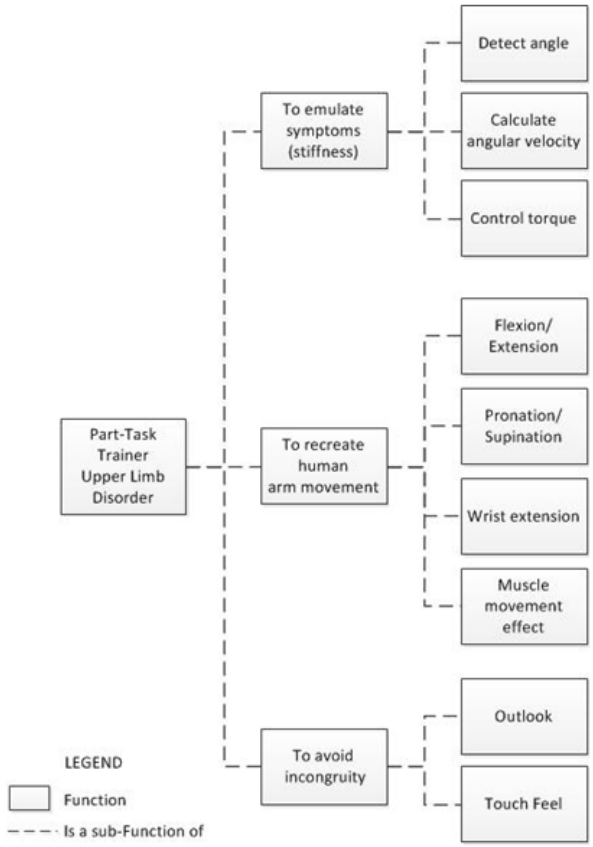


Fig. 3 Function tree of the part-task trainer development

IV. New Curricular Proposal

Before conducting the survey, several opinions from therapists were concerned with muscle and anatomy structure, while other therapists were concerned with the relation to the ethics and the manners of novice therapists, if they trained with a robot simulator instead of a human. To solve these concerns, we proposed a new curricular, and conducted a survey on it. The curricular took into account the important lessons of anatomy and muscle during role-play, giving chances to increase the frequency of symptoms training, with the usage of the part-task trainer, and practice ethics and manners with healthy old people, before engaging directly with real patients during their clinical training.

In the distributed survey, to avoid affecting data collection, the proposed new curricular was not illustrated; as the illustration may have impacted the respondent's results, due to its level of attractiveness. The proposed new curricular is illustrated in Fig. 4 to differentiate the focus of the curricular in three different objective levels 1) to study human upper limb anatomy and muscle, 2) to increase the frequency of training by novice therapists with constant repetition of different levels of symptoms, and 3) to educate novice therapists with ethics and manners towards patients through connection with healthy old people.

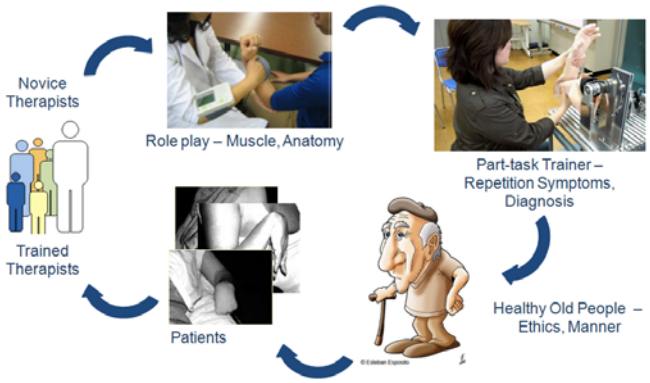


Fig. 4 Illustration of the proposed new therapy education curricular

V. Results

A total of 22 physiotherapists and occupational therapists from Malaysia and Japan, who are involved in the clinical education fields, participated in this study.

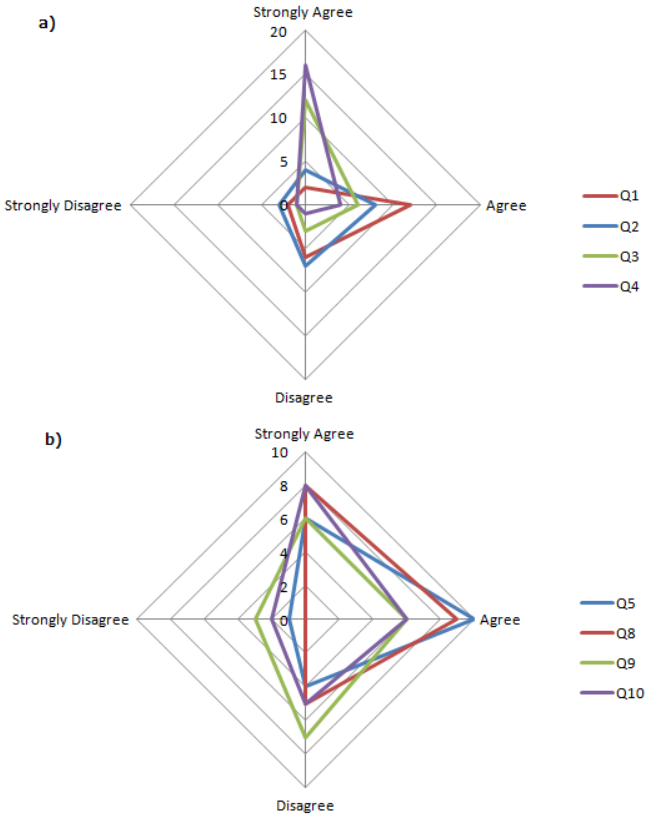


Fig. 5 (a) Therapist's responses towards questions in Section A: Current Therapy Education, (b) Therapist's responses towards questions in Section B: Training Simulator

A. Therapist's Responses towards Current Therapy Education

Based on the results shown in Fig. 5 (a), 81% of the therapists strongly agreed and agreed that by depending only on current training methods to teach novice therapists, there are high possibilities in contributing to variable ratings between raters and intra-raters themselves. 54% believe that novice

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therapists might risk injury to patients during their first clinical contact; 91% of the educators supported the idea that novice therapists should have a higher frequency of training; which is unfeasible if they remained with the current education method, because they only have the chance to practice with friends or their educators, which limits the frequency of their training. When questioned about frequency of student training, 72% of the respondents strongly agreed that the students needed a higher frequency of training before engaging with real patients during clinical rehabilitation sessions.

B. Therapist's Responses towards the Therapy Training Simulator

Fig. 5 (b) illustrates the responses towards the development of our training simulator. 72% of the therapist educators believed that the suggested method and the part-task trainer could be implemented into the therapist's clinical training. 77% (strongly agreed and agreed) had the opinion that the new training method could provide a higher frequency of training to students. 63% of the participants agreed that we could increase the therapist's rating ability and reduce the ratings variability.

C. Implementation of the Part-Task Trainer

Respondents were also asked whether they were interested in the part-task trainer; as explained in the questionnaire. All respondents had not seen the described simulator prior to participating in the survey. 55% of the respondents were interested in the implementation of the part-task trainer in their workplace (as elucidated in Fig. 6).

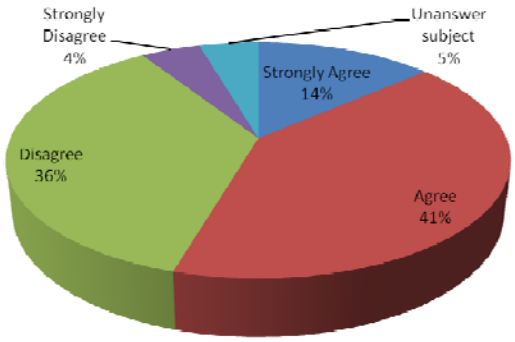


Fig. 6 Therapist's responses towards Questions 6

VI. Discussion

This questionnaire-based survey, which involved 22 physiotherapists and occupational therapists from the education field, was the first of its type to be performed in Japan and Malaysia regarding the current therapy education and the implementation of a new device into that education system.

In this study, therapists found that by depending on current training methods to teach therapy trainees, there were high possibilities for contributing to variable ratings between raters and intra-raters themselves. The suggested education method, of the upper limb spasticity simulator patient, increases the possibility of higher frequency training, which should lead to a better understanding of the accompanying signs; and thus improve rating levels.

In summary, it is suggested that therapists found the part-task trainer to have a positive future in improving clinical training. However, further improvements are required to improve the current part-task trainer, before proceeding to actual simulation in the clinical education field.

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