

# The effects of virtual reality-based physical therapy in stroke patients

Charyong Kim<sup>a</sup>, Won-Kyu Min<sup>b</sup>

<sup>a</sup>Hartnack, Berlin, Germany

<sup>b</sup>Severance Rehabilitation Hospital, Yonsei University Health System, Seoul, Republic of Korea

**Objective:** Final goal of nerve advancement therapy is to provide maximum ability to function independently in life to patients. This paper appraises and describes basic concepts of the virtual reality (VR) based exercise program to improve functional movement for neurologically impaired patients.

**Design:** Review article.

**Methods:** Stroke patients from the physical therapy department while wearing comfortable clothing receive therapy and also VR based motion therapy administered by the therapist in charge. After evaluation of stroke patients, therapy includes an exercise program that is suitable for use with stroke patients; stroke patients wear head-mounted display while in front of the computer, where the camera is located; they follow the action on the screen and the computer perceives the operation of the stroke patients according to subject accomplishment.

**Results:** According to obstacle condition of stroke patients using the method, which is various environments after setting, in stroke patients, there is a possibility of presenting suitable therapeutic environments. The display presentation of the method, which is identical, causes difficulty for all stroke patients. According to subject accomplishment; stroke patients result in execution of repetition training and deepening study, which leads to mobility.

**Conclusions:** The VR based rehabilitation training programs is a difference of the existing video training program, is immediate feedback and compensation method. It will provide rehabilitation training services for the family of the patient whose condition could be improved with rehabilitative therapy where it is a continuous circumstance as a matter of the social welfare facility therapy.

**Key Words:** Rehabilitation, Stroke, Virtual reality exposure therapy

## Introduction

Nerve advancement therapy can generally be used for improvement of the duplication obstacle for stroke patients [1-7]. Therapy consists of Phelps early rising regulation systems, Rood nerve physiological school registry access methods, and the opinion of Fay and Doman-Delacato on nerve muscular reflections, and Bobath motion control and a functional motion accomplishment nerve advancement therapy,

which emphasizes a exercise element, and Kabat proprioceptive neuromuscular palpation laws and Vojta laws, Brunnstrom legal etc. using a concrete method [8]. Nervous disease therapy involves normal attitude controls and muscle activity palpation, inhibition descriptions below taction stimulation for and palpation of the collective motion, which uses resistance motions, and is applied for nerve advancement therapy, which emphasizes the reflective activity in compliance with outside stimulation mainly from physical therapy fields of our country.

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Corresponding author: Won-Kyu Min

Department of Physical Therapy, Severance Rehabilitation Hospital, Yonsei University Health System, 50 Yonsei-ro, Seodaemun-gu, Seoul 120-752, Republic of Korea

Tel: 82-2-2228-3785 Fax: 82-2-364-0509 E-mail: mwk10003@yuhs.ac

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The final goal of nerve advancement therapy is to provide the patient with the maximum ability to function independently in life. The organization of the central nervous system (CNS) is complicated, and is composed of many systems and a lower system. Lower part of the system will adapt to changes in environment and will cause changes of centrality stimulation; therefore, there is a possibility of directly influencing the structural organization of the CNS. Consequently, change of nerve structures of the sense exercise form the normality and abnormality of the systematization, which is the possibility of making systematization or non-systematization is possible; the operation is controlled according to nerve and musculoskeletal system conditions. Centrality and centrifugal characteristic selective operation of the trunk and limbs, which has connection with posture adjuster mechanics, rehabilitation does not prompt the compensation, but is the learning process which recovers exercise control function. The electric generation of the cell associated with this learning process changes according to subject in exercise control re-studying duration.

## Methods

Stroke patients undergo the limit of palsy side upper extremity functions, and, in particular, the decrement or disappearance of one piece of upper extremity function decreases the rotary ability from the trunk, restricts the operation of the different regions, and causes inefficiency, by causing functional disturbance of the upper extremity for hemiplegia patients when performing functions of daily life and becomes the cause of the greatest obstacle. In comparison of the upper extremity in the summer solstice and the time of nerve school registry, recovery is slow and miserable [9], it compares weight in the summer solstice function ambulation and it is minor because the operation being demanded is more complicated. In addition, for the upper extremity, it can't be thought separately for attitude maintenance, gravity and the ability to move, and the trunk which reacts effectively in distal part operations with ability. Therefore, it will be able to think therapy method which may secure the stability of the trunk it uses. The problem point has been proposed in various clinical research studies; however, studies on the therapeutic effects of the existing therapeutic arbitration method and the necessity of a new arbitration method have been reported [10-13]. This stands for the patient where the recovery of motor function is possible.

With impairment of sensory function in planning of activities of daily living and obstacles in daily life the disability may occur. Sensory function judges an ability and the situation, in order to understand the work performed in our daily life environment, which is a function, and it decides and adapts to the environment where ones is placed [14]. In general to be a territory where the power of concentration and memory is basic, planning power (planning) and systematic hour height ability (organization) and problem solving ability (problem solving), abstraction ability etc. is included to the high position level and it is inaudible and must become the foundation, the integration of language and hour perception ability. It stands in the patient where the recovery of motor function is possible, impairment of stamp function becomes the element of rehabilitation with difficulty, and impairment of this function makes an obstacle that would bring about independent functional accomplishment [15].

Consequently, impairment of stamp function bypasses the problem of stamp function itself, and recovery and attention power of motor function, memory and perception power; stamp functions show significant growth in order to operate with the obstacle element, which is important in problem solving power etc. various branch territory. Becoming like this rehabilitative therapy foundation, plasticity (plasticity) of the brain, namely, applies the ability of functional re-recovery with the maximum and prompts the reconstitution (reorganization) of the impaired brain organization. Cognitive-rehabilitative therapy, which is used with a computer, was started in compliance with actively and they are universally received these days [16].

In cognitive-rehabilitative therapy, the computer program knows only therapy pliability and control of therapy for shortening of hours; the measurement is objective; in the patient, the feedback (feedback) is immediate, and there will be a possibility of adjusting patient necessity according to the level selected and there is a strong point, a degree of difficulty it will be able to control. Zoltan and Siev [17] reported on cognitive-rehabilitative therapy focuses on uses of computer to study the attention concentration and memory of 40 patients with cognitive-rehabilitation training brain injury. From one research study on the object memory and problem solving ability, they reported clear improvement from attention power concentration.

In addition, there is virtual reality (VR) training, which it is used mainly in the clinic. In VR, computer hardware and software are similar and the user experiences a great disaster

style simulation (interactive simulation) [18].

The resultant reliability and the propriety, which use a VR method for rehabilitation of patients with brain damage, are highly advanced in appearance [19], for balance of stroke patients who use a VR program [20] for walking [21] and upper extremity function [22] in research studies. However, most VR training is in the form of a game which uses Wii Fit, Play Station, and X-box.

It used nerve advancement therapy from the hospital and body movement; in addition, it was various and it was controlled by movement, leading to maintenance or normal condition and moving muscle tone where appropriate. It re-studies, and, with attitude control, it is functional movement and it teaches functional condition of the patient, with the greatest emphasis on development of the remaining ability of the maximum, which is suitable. The next are rehabilitation training programs, which are used primarily in the hospital.

**Table 1.** The virtual reality (VR) based exercise programs in physical therapy where the general extraction program is used when it's possible

Activities	Mat exercise	VR based mat exercise
Supine	General postural control	Upper limb control
	Head control	Lower limb control
	Upper limb control	
	Lower limb control	
	Supine to prone (rolling), supine to sitting	
Prone	General postural control	Upper limb control
	Head control	Lower limb control
	Upper limb control	
	Lower limb control	
	Prone to supine (rolling), prone to quadruped, crawling, creeping	
Sitting	Sitting posture	Sitting posture
	Sit on mat with arm(s) propping	Long leg sitting
	Long leg sitting	Sit on bench
	Right/left side sitting	Righting reaction
	Sit on bench	
	Righting reaction	
Standing	Bench to standing	Kneel standing
	Floor to standing	One leg standing
	Kneel standing/half -kneel standing	
	Standing with balance	
	One leg standing	

### Application method in of virtual reality based exercise program

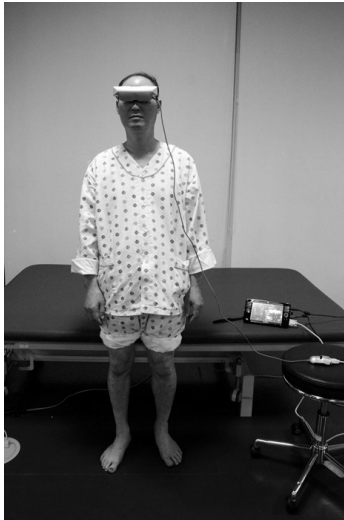
VR based exercise programs in physical therapy where the general extraction program is used when it's possible (Table 1).

If attitude controls and muscle activity palpation are normal, inhibition is described below palpation of the collective motion, which uses tractions stimulation for resistance exercise, and the computer applies nerve advancement therapy, which emphasizes the reflective activity in compliance with the outside stimulation with the mixture of actual base rehabilitation training programs for which it is programmed; together, even in cognitive-functional improvement it expects with the functional motor development of nervous disease patients (stroke, cerebral palsy etc.) with the fact that the help will become.

The basic concept of the VR based exercise program (Figure 1) is the same. In the physical therapy department, there are two physical computers (server and client) with two cameras, where the infrared ray filter is affixed and the infrared ray light-emitting diode (LED) band, head-mounted display (HMD) etc. is established. Stroke patients from the physical therapy department receive therapy while wearing comfortable clothing and also receive VR based motion therapy administered by the therapist in charge. After providing the exercise program from the VR environment, data base construction, circumferential situation recognition and reaction conduct control technical etc., it is applied using audiovisual expressive techniques using the camera recognition control technique and a sentimental feedback of graphics and vision base; the method could be adapted to



**Figure 1.** Virtual reality system with head-mounted display.



**Figure 2.** Apply to virtual reality based exercise program.

daily life with improvement of complement percentage walking ability, and, in order, the sense of balance, which is a tribe of oneself/motor functions and cognitive functions, the audiovisual models and cognitive information; the real-time operation recognition uses infrared ray LED and the model operation, which is stored in advance, the accomplishment speed and accuracy of stroke patients for whom it follows.

## Results

Therapy after evaluation of stroke patients includes a exercise program that is suitable for use with stroke patients; stroke patients wear HMD while in front of the computer, where the camera is located, and is the operation is presented on the screen; they follow the action and the computer perceives the operation of stroke patients who are being trained [23] (Figure 2), according to subject accomplishment; yes or no from stroke patients results in execution of repetition training and deepening study, which leads to mobility etc. at the next step that is executed. According to obstacle condition of stroke patients using the method, which is various environments after setting, in stroke patients, there is a possibility of presenting suitable therapeutic environments. The display presentation of the method, which is identical, causes difficulty for all stroke patients. Therefore, regarding eye-glasses (sunglasses etc.), for patients who like wearing eye-glasses similar to HMD, it will induce an incentive to wear Sikkim; In the case of not possible to wearing HMD es-

tablishes a projection on the front and it will be able to apply the monitor method which it applies.

## Discussion

Currently, nerve advancement therapy is used in rehabilitation hospitals which take charge of rehabilitation of patients with nervous. This therapy involves body movement and it was various and it was controlled by movement, leading to maintenance or normal, and moving for muscle tone where appropriate, and motion is re-studied where it is functional. With attitude control, it teaches the remaining ability of the maximum that is most suitable in functional condition of the patient and minimizes development of obstacles, in motion where it is normal in order to be near, it recovers a function and it has an object to make.

In the hospital, the patient's condition becomes stabile, the patient leaves the hospital and moves toward the family, and, from the hospital or material tube etc., returns from rehabilitative therapy it is receiving abroad. Patients who received therapy for a long period require management. This results in an economic charge, which is caused by hospitalization therapy for a long period; in the tribe of rehabilitation hospitals and therapy, where continuation is difficult, even after leaving the hospital, it is believed that the mixture of actual base rehabilitation training will provide rehabilitation training services for the family of the patient whose condition could be improved with rehabilitative therapy where it is a continuous circumstance as a matter of the social welfare facility therapy, where it is difficult to provide treatment continuously. Like this situation, nervous disease and long-term housing that accommodates senile diseased patients is the same. The long-term program from the acceptance facility conducts therapy for protection of independence; it has been accomplished in the center. This the enemy compares in the therapist of the personnel and the patient who has become hospitalized (accommodating); using of the method will be able to solve this problem point in the mixture of actual base rehabilitation training, and it will be able to provide rehabilitation training services with the individual and the group if necessary.

For rehabilitation services of the delay disabled person who participates in a mixture of actual base rehabilitation training programs, it is believed that additional research will be necessary.

First, there is a difference of the existing video training

program is immediate feedback and compensation method. However, the exercise program that becomes simplified (simplification of type and exercise method of the program) because of quality is a mixture of actual base, which uses the computer, the amendment of which will reach the plan it will be able to complement if necessary.

Second, according to the quality of the disabled person, somewhat degree-fixed training is possible, but it needs to be studied continually of individualizing approach access method which considers the disability standards and conditions of patients, various patterns and family, social environment effects, but not with standardized treatment method in realistic treatment situation.

The third, in patients with nervous disease, it is limited only in motor function disorder, in the territory (language functions and cognitive functions, emotional condition etc.), where it is various to extend, if it is a complex syndrome the obstacle appears, it is necessary to assess in a various sides.

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