REHABILITATION WITH THE EASE OF A GAME

Picture 1. Hand training device designed to assist movement improvement

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A new approach to movement training in cerebral palsy patients has been developed at the International Clinic of Rehabilitation in Ukraine. Positive results have been achieved using the combination of physical therapy and computer games. While training on a specific movement, the child is playing an exciting computer game. Specially designed computer games both provide high motivation for a child for the correct movement performance, and allow for recording the child's motor improvements.

Previous issues of *Cerebral Palsy Magazine* introduced the fundamentals of the Kozijavkin rehabilitation method (March 2004), and the use of the "Spiral" movement correction suit (June 2004). For further information about the Kozijavkin method, please visit www.reha.lviv.ua. This is a follow-up article in the published series, which is devoted to computer game-training devices aimed at movement training of children with cerebral palsy.

Introduction

Forming the correct movement is one of the crucial tasks in the rehabilitation of cerebral palsy patients. To increase the patient's movement range, gain muscle strength, improve

Picture 2. Training chair helps to train the trunk movements during the game

movement speed and coordination, mechanical training devices are traditionally used. The one most commonly used are training devices where the patient performs the necessary movement by applying a specific effort. The disadvantage of these devices, specifically when working with children, is the monotony of the practice session, as well as lack of motivation on the part of the child to perform long term regular training.

The International Rehabilitation Clinic staff has suggested that a useful, yet boring training procedures be combined with interesting and exciting computer games. There hardly is a child who does not like computer games, is there?

For this purpose game-training devices have been designed. They are equipped with sensors that record certain movements – flexing or rotating the hand, bending the trunk, flexing the foot, etc. The data from the sensors is used to control a computer game. The movement of a computer game hero corresponds to the patient's hand, body or foot movements. To enhance strength training, movement resistance of different levels may be set.

Special computer games have been designed to work with these training devices. The essence of the game lies in increasing the movement range and speed, and improving the movement precision. During training sessions, the complexity level is gradually increased requiring more precise movements. An interesting game line acts as a stimulus for the patient to perform the correct movement, to increase movement speed and range, and to improve reaction and eye-hand coordination.

Simultaneously, the software may perform diagnostic functions. During the game some important parameters, movement range and speed, and game results, are being measured and presented at the game screen. This data is saved and can be used to measure the patient's progress.

In order to increase the patient's emotional involvement, the elements of virtual reality can be utilized. In this case, special virtual reality glasses are used instead of a monitor, and stereo-headphones are used to produce the sound.

Game-training devices are a part of the movement correction program, which is an important element of the Kozijavkin rehabilitation method. At the present time a number of devices for game-based movement training have been designed at the International Clinic of Rehabilitation, namely, a hand-training device, a training chair, and a multipurpose game-training device. These devices can be connected to the home computer and do not require special computer knowledge.

Hand-training device (Picture 1)
The first device in the series is the hand training device designed to improve the hand movement performance. Depending on the device handle position, flexion-extension or rotation movements are practiced. During the training session the patient's forearm is fixed on a special elbow-holder which can be adjusted for the height.

The resistance controller sets the necessary load, with low resistance during the initial training sessions and further increases in the resistance level.

Picture 3. Screenshot of 'The Bee" game designed to train hand rotations.

Two games have been designed to accompany the hand training device function. They are 'The Bee" and "Cossacks."

"The Bee" game is aimed at hand rotation movement training. This game tells the adventure story of the bee that is collecting honey from flowers at a green meadow. The child controls the bee's movements at the game field by his/her hand movements. When the bee touches myrtle or a daisy, a drop of honey is added to its pail. After collecting the full pot of honey, the bee proceeds to the next game level. Depending on the game level the bee has to escape toadstools, a bumblebee, or hide from the rain. To train the flexion-extension hand movements, the "Cossacks" game has been designed.

Picture 4. Screenshot of "Cossacks" game aimed at practicing flexion-extension movements.

While performing the flexion movement of the hand and thus operating the game-ship, the game player fights the enemy fleet traveling over rocky islands. At the next level, the game player tries defeat his/her enemies while racing on horseback.

Since every child has their own motor potential and restrictions, it is necessary to set the game parameters at the starting practice session, i. e., indicate the movement range at which the patient can perform movements. Later, the information about the initial game parameters and data about each game session are saved in the database, and can be used to analyze the practice progress in the future.

To estimate the efficiency of computer game-based devices,

the International Rehabilitation Clinic staff has conducted a preliminary pilot study in a group of 30 children with spastic hemiplegia.
The research findings show that the use of the hand training device leads to improvement in grasping motor function, increase in active movement range and the development of hand strength.

Training Chair (Picture 2)
The training chair was designed to develop trunk coordination and improve postural control. Sensors in the chair define the position and motion of the trunk in three planes – bending forward and backward, side bending, and turning. This information is sent to the computer and is used to control the computer game.

The "Bee in the Park" a three-dimensional game has been designed to work with the training chair. The child is sitting in the training chair with his back fixed to the chair back. During the game the child controls his/her game object in the three-dimensional virtual game world by bending forward, backward, sideways or turning his/her trunk. Traveling in the park and performing the game tasks the game player fights other game heroes – a spider, a bumblebee, or a caterpillar. Jumping over the bushes or barriers the child tries to find and collect as many flowers as possible can, and escape the enemy. The use of the training chair allows one effective improvement of trunk motor control, develops movement coordination and trains for muscle strength.

Picture 5. Screenshot of the game aimed at practicing trunk movements.

Multipurpose Game-Training Device (Picture 6)
The most recent accomplishment is the design of the multipurpose game-training device, which can be used to practice movement training in different joints. It is a rather simple device which is connected to the limb above and below the joint, and transmits the movement information to the computer. It can be used to train movements in the ankle, knee, elbow, and wrist joints.

Picture 6. Multipurpose game-training device can be used to train movements in different joints.

To effectively perform the game training sessions two devices of this kind can be used simultaneously, thus, the computer game can be controlled by the movements of two limbs.

Picture 6. Screenshot of "Dragonfly on the Island" game

The game about the adventures of the "Dragonfly" traveling on the tropical island has been designed to work with the multipurpose game-training device. Using the guiding points, the dragonfly tries to find the right way and avoid meeting enemies. One finding the coconut, the dragonfly has to break it with swift and frequent movements in order to receive the prize. An important feature of the game is that it combines two types of movement training: smooth and coordinated movements are required to move correctly on the game field, and swift movements with maximal volume and frequency which are required to break the coconut found on the tropical island.

Conclusion

To increase the patient's motivation in performing the correct movement, and to improve movement speed, frequency and range, a series of computer game-training devices have been designed, which combines mechanical training with an interesting computer game. While performing a certain exercise and practicing movement in a certain joint, the patient simultaneously plays the computer game. Due to their exciting animation and interesting game-line, the rehabilitation games provide an effective performance of the game session, and stimulate the development of the patient's motor functions.

Dr. Kozijavkin's Upcoming Visit to the United States.

The Kozijavkin Method was created 15 years ago in the Ukraine and so far, more than 15,000 patients have been treated by this method, including about 7,000 from Germany, Austria, Switzerland, and France.
(Information about the Kozijavkin method is available at www.reha.lviv.ua).

Statistical analysis of medical records of a group of 12,256 patients treated by the Koziavkin Method confirmed the high efficiency of this rehabilitation system. The following are just some of the results which were noted:
-Muscle tone normalization was noted in 94% of the patients.
-Improvement of head control in supine position was noted in 75% of the patients.
-62% of the patients who were unable to sit before the treatment have learned to do so.
-19% of patients began to walk without assistance.
-87% of patients who had spastic fisted hands were able to open their hands and they became functional.

In response to the multiple requests, Prof. Volodymyr Kozijavkin, MD, Ph.D., will be visiting the United States during the month of October 2004. During his visit, Prof. Kozijavkin will hold meetings with doctors, therapists, patients and their families.

The following is the schedule of Prof. Kozijavkin's visit:

October 12 and 13 in the San Francisco area
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