Research on Virtual Reality Training and Evaluation of Sports Rehabilitation

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Abstract: The research on exoskeleton upper limb rehabilitation training robot has achieved universal recognition in the field of rehabilitation. Compared with traditional rehabilitation methods, rehabilitation robot optimizes the rehabilitation training effect of hemiplegia patients, and combines virtual reality technology to make the rehabilitation training effect more obvious. The rehabilitation process is moving towards procedural, digital and simplified. At the same time, rehabilitation evaluation plays a crucial role in the rehabilitation of patients.

1. Introduction

With the changes in social and economic development and disease spectrum, the medical model has also changed, from the disease treatment medical model to the prevention health treatment rehabilitation model. For the rehabilitation of stroke patients, the traditional clinical methods mainly include ultra-early basic care, mid-term massage, massage, and later acupuncture treatment, but these traditional methods are mainly based on freehand rehabilitation, but Such treatments rely on experienced physicians, rehabilitation cannot continue, if the effect of rehabilitation alone at home is significantly worse. For upper limb rehabilitation, such as shoulder and shoulder strap activities should pay attention to the movement of the scapula and the internal and external rotation of the shoulder joint, and the doctor needs to protect the shoulder joint by hand to prevent the shoulder joint dislocation. It can be seen that although the traditional treatment methods are still widely used in clinical applications due to differences in treatment methods and personal experience of doctors, there are also unavoidable drawbacks.

2. Theoretical basis for the design of rehabilitation robot systems

The human cerebral cortex controls the entire limb movement of the human body and is the central part of the entire nervous system. The cerebral cortex controls the limbs through nerve impulses between nerve cells. The motor neurons in the nervous system control the human body by controlling muscle contraction movement. The movement of the arms and fingers, the theory of cerebral remodeling, through the regeneration of axons of central nervous cells, the germination of dendrites, etc., reorganize the network system of a functional cell group in the central nervous system to realize the process of functional reorganization. Anatomically, the brain controls the limb movement to be cross-dominated. The cortical spinal side bundles intersect with the vertebral body in the medulla, controlling the limb movement on the other side. The formation of hemiplegia is mainly caused by the neuronal cells or synapses of one side of the cerebral cortex of a stroke patient and the dyskinesia of the other limb. Due to the continuous development of brain functional imaging technology, the theory of living brain remodeling has been further researched and proved. Whether in animal experiments or clinical medical phenomena, it is found that brain function lost after brain injury can be restored to some extent. This indicates that in the recovery process of brain damage, there are other recovery mechanisms different from the regeneration mechanism, which can be divided into structural plasticity and functional plasticity.

Based on the theory of brain remodeling, the brain can accomplish a certain degree of reorganization and recovery in both structure and function, and can re-send the transmission of nerve impulses from the central to the spinal cord. How to make the recovery of the nervous system promote the recovery of the entire motor function, but also the support of the theory of sports

re-learning. The theory of sports re-learning mainly regards the recovery training of motor function after central nervous injury as a process of re-learning or retraining. The method is based on multidisciplinary theory, oriented to homework or function, emphasizing the importance of active participation and cognition of patients, and regards the recovery training of motor function after central nervous system injury as a process of sports re-learning. The training method of sports re-learning was proposed by Janet Carr et al. in Australia in the early 1980s. The theory holds that most of the training movements do not rely on the planned pattern of nerve-to-muscle output, but on the exercise program formed in the brain by repeated learning. The method is proactive, scientific, pertinent, practical and systematic. The patient actively performs some rehabilitation training during exercise and re-learning, performs repetitive movements on the corresponding bone joints or muscles, and repeatedly trains the serious patient positions, and then applies the methods learned in the rehabilitation training to daily life. For example, the left and right movements of the wrist joint can be applied to the action of wiping the Table and wiping the glass, and the elbow joint and the shoulder joint are used to complete the daily movements such as lifting the pants.

3. Virtual reality rehabilitation training and exercise control evaluation

Virtual reality Whether constructing a training game or a motion evaluation system, the core part is to create a virtual environment, and the construction environment firstly imports or draws the physical model into the virtual environment, and then performs rendering, mapping, and stereoscopic implementation. The virtual reality environment of the constructed virtual reality rehabilitation training system is mainly composed of virtual human, virtual physical and virtual environment elements. The virtual human and the virtual physical object are the physical object model. The solid model is the basic unit that constitutes the virtual scene, and also forms the three-dimensional image. The important unit, in the virtual reality rehabilitation training software design, the solid object model refers specifically to human body modeling and other daily physical models. In virtual reality, the modeling of virtual human body is the most complicated. Due to the complexity of the human body and the limited computing resources, there are many problems to be solved in the research. The main virtual human body modeling methods include interactive modeling, 3D measurement based modeling, image based human reconstruction and human deformation techniques. Among them, the interactive human body modeling technology is widely used, mainly using modeling software modeling, and the modeling technology is relatively high; the human body reconstruction of three-dimensional measurement is a relatively straightforward method, which requires the use of three-dimensional human body measurement technology, laser scanning technology, etc.; image-based human body model The reconstruction method is based on the principle of computer vision, using multiple images to synthesize and then recover its three-dimensional shape; the human body deformation technology is completed by secondary modeling of existing entities. In the construction of rehabilitation virtual reality environment, not only the human body model, the construction of the physical model, but also the kinematics analysis of the model are needed. At the same time, for the clinical and engineering needs, input data and feedback data are also necessary, so the rehabilitation of this subject the virtual reality system adopts interactive human body modeling technology, that is, 3D static model is applied by 3Ds Max, and then OpenGL is used to render the model.

4. Complex robot safety and effectiveness evaluation

In the process of rehabilitation training for stroke patients, it is important to improve the training effect of patients, but the first condition is to ensure the safety of patients. In the upper limb exoskeleton rehabilitation training robot system, it is necessary to consider the function realization of the rehabilitation robot, and also prevent secondary damage of the affected limb, such as excessive muscle stretching, excessive joint rotation, skin allergies or burns. Through clinical safety verification, good feedback can be provided for both the hardware and software components of the system. For the safety of the upper limb rehabilitation robot system designed for this topic, we need

to consider the following issues: 1) the wearing comfort of the upper extremity exoskeleton robot; 2) the training time and training intensity of the virtual reality game; 3) the matching finger wrist virtual reality Auxiliary gravity adjustment of the training equipment; 4) Stimulation frequency and stimulation intensity of the functional electrical stimulator. In addition, the entire system needs to be humanized, and the system enters the patient's comforTable experience for clinical applications. Because the upper extremity exoskeleton rehabilitation training robot designed by this subject is unpowered, that is, no motor-driven robot is needed, the patient can actively control the robot for training. Because the mechanical design is completely in line with the human body motion principle, the brake block is added at the corresponding position. Limit displacement and angle, so the patient's limb flexion and extension, skin allergies, skin burns and other conditions during training will hardly be encountered. In order to enter the clinical practical application of the system, the corresponding questionnaires are designed and graded, so that patients can use the comfort rating of the system, and a more mature feedback system is set up, which provides a strong basis for hardware and software updates.

There are many methods for assessing motor function in patients with hemiplegia due to stroke, which are often assessed using a scale. The evaluation of motor function mainly includes muscle strength assessment, joint mobility assessment, muscle tension assessment and balance and coordination function assessment. Patients with stroke are generally assessed on the scale before, during and after treatment, and the treatment plan is formulated and revised according to the assessment results and the effect of rehabilitation treatment is objectively evaluated. Commonly used scales include the Brunnstrom scale and the Fugl-Meyer scale. The Brunnstrom scale is simple and practical. It is the most widely used clinically. According to the stage of exercise recovery, the occurrence of the joint exercise of flexor and extensor muscles and the degree of selective muscle activity appearing in the coordinated exercise mode are used to classify the motor function. An important part of the rating scale is the assessment of activities of daily living (ADL), which are continuously assessed during the rehabilitation training phase to determine the effectiveness of the rehabilitation. After all, the main purpose of rehabilitation training is to enable patients to improve their quality of life and to allow the affected limb to gradually approach the level of normal life of normal people. Basic or physical activities of daily living (BADL or PADL) and instrumental activities of daily living (IADL). Nowadays, a series of clinical scales are used for the evaluation of rehabilitation training effects, and DASH scales and Barthel scales are used more. The scale is mainly for the evaluation of daily life index, and is continuously evaluated during the rehabilitation training stage, so that the rehabilitation effect can be judged. In order to facilitate the patient to effectively evaluate the muscle strength before and after the upper limb rehabilitation training, while reducing the tedious work of the physician and increasing the efficiency of data analysis, the MFC program is specially used to add the DASH scale evaluation to the rehabilitation training game software and the motion control evaluation software. Module. The module can reflect the score of the patient scale in real time, which can evaluate the muscle strength of the patient at the first time and ensure the safety of the rehabilitation training. It can also compare the scores of the pre- and post-evaluation and obtain the effective conclusion of the rehabilitation training. The entire DASH rating scale program module includes patient information collection, gauge filling, gauge calculation and analysis, etc. This module can be added to any compiled virtual reality rehabilitation training or motion control assessment system as part of the auxiliary assessment. The patient completes the DASH scale by clicking the corresponding option. The scale can get the corresponding score in the first time, and the corresponding analysis is made. The score of 0 indicates that the upper limb function is completely normal, and the score of 100 indicates that the upper limb function is extremely limited.

5. Conclusion

Give full play to the advantages of combining virtual reality technology with rehabilitation therapy. Not only the music and sound effects are added to the virtual reality software, but also the group training and the patient condition feedback module are added, and the module is encouraged

to enable the patient to recover in both the motor function and the psychology. System hardware and software updates. On the basis of a certain amount of clinical experiments, physician recommendations and the latest achievements of the exhibition, the targeted rehabilitation work of the upper limb rehabilitation training exoskeleton robot hardware and virtual reality training software has been carried out, which has further improved the clinical application.

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