Virtual Reality as a Tool in Pediatric Rehabilitation

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Abstract

This article reviews the usefulness of virtual reality technology in pediatric rehabilitation.

Introduction

Virtual reality (VR), also known as virtuality, is a term applied to computer simulated environments that can simulate physical presence in places in the real world, as well as in imaginary worlds. The VR user experience can be accomplished using a wide variety of interaction devices and sensory display systems. In Immersive VR- Computers, head-mounted displays (HMDs), body-tracking sensors, specialized interface devices, and real-time graphics are used to immerse a participant in a computer-generated simulated world that changes in a natural way with head and body movements to create a life like experience. The main aim is to replace the outside world perceptually with that of a simulated environment (delivered within a HMD) to create a specific user experience. In Nonimmersive VR a three-dimensional (3D) graphic environment is created on a flat screen monitor or television within which the user can navigate and interact (Eg- Console video games).

Originally, VR technology was solely recognized for its entertainment value; however, in the past decade, its application has been expanded to pain management, physical rehabilitation and the treatment of psychiatric disorders (e.g., phobias, post-traumatic stress disorder and anxiety disorder). It has been most frequently used in medical settings as a means to attenuate pain perception, anxiety and general distress during painful medical procedures, such as wound care, chemotherapy, dental procedures and routine medical procedures.

Discussion

Virtual reality for motor rehabilitation

VR electronic games may lead to improved motor skills. A critical feature of video capture VR games is that it requires arm, leg or whole body movement. VR electronic games improve children's skill by providing gross motor practice involving a high level of visual-spatial integration, but in a context which is private, and provides strong motivation by enjoyment of the game and the challenge of self-competition. Improvements in performance in VR are useful if they lead to improvements in real world performance. VR training also leads to greater enjoyment of rehabilitation and improved motor confidence in the real world.

Karin et al investigated the effect of adopting a VR scenario in children with gait problems. The individual's level of active participation was compared to a regular training session involving therapist encouragement and motivation. The motor outcome for a combined VR and therapist environment was better than either VR alone or the therapist acting alone. Studies have shown that computerized visual feedback is a valuable adjunct to robotic-assisted gait training. It helps in increasing patients' motor output, involvement, and motivation during gait training, similar to verbal instructions by a therapist [1, 2]. Schuler et al showed that the surface electromyography output in both healthy and children with gait disorders was found to be significantly higher if virtual reality was used[3].

VR has potential benefits for children with Cerebral Palsy (CP). Studies have shown that out of motor capacity, visual-perceptual skills and social participation, positive outcomes were seen in at least one domain in children with CP when VR was used. Functional balance and mobility improved in adolescents after short duration VR intervention and the gains were maintained 1 month post training [4]. Virtual reality also has a positive effect on playfulness in children with cerebral palsy. These environments allowed creativity, persistence with the task, pleasure, and a certain degree of control[5]. Weightman et al developed a home-based rehabilitation exercise system incorporating a powered joystick linked to a computer game, to enable children with arm paresis to participate in independent home exercise. Pre- and post-intervention movements on the standardized task showed decreased duration and increased smoothness[6].

Virtual reality and autistic spectrum disorders

Autism spectrum disorders (ASD) are characterized by deficits in social interaction, communication and repetitive or stereotypic behaviour. Virtual reality (VR), a simulation of the real world based on computer graphics, can be useful as it allows instructors and therapists to offer a safe, repeatable and diversifiable environment during learning[7].
Children with ASD demonstrate atypical viewing patterns during social interactions and thus monitoring eye-gaze can be valuable to design intervention strategies. Difficulties in understanding symbolism have been documented as characteristic of autistic spectrum disorders. VR environments offer the advantage, for teaching pretend play and for understanding imagination, of it being possible to show these imaginary transformations explicitly. This would show a significant advance in pretend play abilities after the intervention. Children with more severe ASD and Attention Deficit Hyperactivity Disorder (ADHD) might benefit from the isolation, controlled focus, and user feedback that headsets provide. New VR programs are being used to teach fire and street safety for children with ASD. A series of VR programs that taught real-world actions to children with both ASD and ADHD have been developed over the past few years. An engaging animated teaching avatar and the particular gameplay is useful for younger children whereas older children are motivated more by peer interaction in a virtual shared space[8].

**Virtual reality and pain management**

Children with burns undergo multiple, painful and anxiety-provoking procedures during wound care and rehabilitation. Nonpharmacological therapies such as virtual reality, relaxation, and cartoon viewing, music, massage and hypnosis can be combined with pharmacological techniques and used to limit the use of drugs (and hence side effects), as well as to improve patient participation and satisfaction. Gold et al. demonstrated the efficacy of a VR Head mount display game “Street Luge” as a paediatric pain distraction tool during i.v. placement. The evaluation revealed an adequate level of presence, no simulator sickness, and significantly more child-, parent-, and nurse-reported satisfaction with pain management[9].

VR pain distraction is a promising tool for decreasing pain, and anxiety in children during acute medical intervention, burns dressing and chemotherapy. However, further research with larger sample sizes and other routine medical procedures is warranted.

**Conclusion**

Virtual reality has penetrated every field of medicine, including rehabilitation. VR which was once considered expensive and cumbersome has in the recent years become easy to use and relatively inexpensive which can be used in everyday medical practice. In the coming years Virtual reality has the capacity to revolutionize the world of medicine as we know it.

**References**


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