ORIGINAL RESEARCH PAPER

Physiotherapy

EFFECTIVENESS AND USE OF TECHNOLOGY IN GAINING FUNCTIONAL INDEPENDENCE IN CEREBRAL PALSIED CHILDREN: A NEW TECHNOLOGY PARADIGM

KEY WORDS: Cognitive, Posture, Technology, Joystick, Robotic.

Pardeep Pahwa Lecturer in Physiotherapy, Composite Regional Centre for Persons with Disabilities, Near Mahamaya Temple, Sundernagar, Dist. Mandi, Himachal Pradesh, India

ABSTRACT

Cerebral palsy children are having disorders of movement and posture. Cerebral palsy affects body movement, muscle control, muscle coordination, muscle tone, posture and balance. Assistive technology has the potential to enhance independences in mobility and communication of the lives of all people, including infants and toddlers with cerebral palsy, by providing the means to actively participate in daily activities. Rehabilitation programmes are changing rapidly due to influx of new technologies that provide more pervasive and faster promoting the education of children with special needs within the classroom and in outskirts.

Introduction:

Cerebral palsy is one of the most severe disabilities in childhood which is a disorder of posture and movement due to a defect in the immature brain.[1] Cerebral palsy is "an umbrella term covering a group of non-progressive, motor impairment syndromes secondary to lesions of the brain arising in the early stages of development". Causes of cerebral palsy arise from contributing conditions like adolescent pregnancy, low socio-economic status, poor health, malnutrition are associated with increased risk of cerebral palsy in children. Cerebral palsy can lead to various associated disabilities like vision, hearing, speech, motor and cognitive problems.[2]

Existing technology for cerebral palsied children -

Technology especially assistive technology has the potential to enhance independences in mobility and communication of the lives of all people including infants with cerebral palsy, by providing a means to actively participate in daily activities. The main objective of this study is to better understand whether technologies are useful in gaining functional mobility and communication and facilitating the process of rehabilitation in order to improve the empowerment of cerebral palsy children. Various technologies have been summarised for cerebral palsy children:

1. **Sensor- based music technology -** Sensor based music technology is based on infrared or ultrasonic sensor controllers which uses infrared or ultrasonic beams and used to produce sound through an electronic keyboard. Physical gestures and movements are translated into music using "movement-to-music" technology.
2. **Movement to Music (MTM) and Virtual Music Instrument (VMI) -** There have been advances in music technology in past years. The current Virtual Musical Instrument system has been in development since .This system has the potential to address goals in the physical, cognitive, communication, sensory, and social domains.[3]
3. **Feedback joystick -** Reinkensmeyer et al., 2003, implemented a force feedback joystick for patient to investigate speed, co-ordination, and strength. Nair et al. 2003 developed a system to use a commercial force feedback steering wheel to assess patient's performance for a racing car game having potential for improving physical abilities with well-designed exercise program in combination with appropriate technology. The focus of forced feedback joystick is area of arm movement with a mechanised system that allows the child to undertake relevant exercises which are fun to do may be a useful adjunct to the conventional treatments. The device is useful in assisting appropriate upper-limb movements in children with CP.[4]

Assistive technology mobility devices for CP - Mobility devices help CP children to gain their mobility and should be prescribed by professional staff according to the patient's needs. The device should be appropriate for patient's functional abilities and should not hinder child's developmental progress. There are basically two groups of assistive devices for such kind of children with mobility problems: the alternative devices and the empowering devices. These devices are usually advanced wheelchair-based devices known as Autonomous Robotic Wheelchairs (ARW) which can be considered a specialized version of autonomous mobile robot (AMR).

The Lokomat R is a driven gait orthosis that automates locomotion therapy on a treadmill and improves the efficiency of treadmill training. The Gobot is a special vehicle that enables mobility for children with CP which moves easily from a horizontal to a vertical position having tray, hip, lateral supports and full foam knee supports.[5]

CosmoBot™ A child-friendly robot is motivating toy to interact with a child in context of entertaining games and activities while addressing developmental and educational goals. The child can control head, arm and mouth movements and can activate a set of wheels hidden under his feet to drive him forward, backward, left, and right. Children interact with CosmoBot™, controlling the robot's movements and audio output, using a variety of gestural sensors and speech recognition, while actively targeting therapy goals.[6] Due to the physical limitations, people with Cerebral Palsy have traditionally had fewer opportunities to make music or dance. Motion tracking can palliate this inequality, since it permits any movement to be mapped to music and sound by two sensor systems: a video-camera based system and electrode-based physical touch system.[7] The recent literature concluded that "SG shows enough evidence to be included within conventional treatment of CP children since it proved to be efficient for increasing patients' motivation". Recent applications of SG 'serious game' for children with CP include to improve postural control (Wade & Porter, 2012) and to improve upper limb motor outcomes represented as lines, rectangles and other objects.[8]

MIRA (Medical Interactive Rehabilitation Assistant) is a software platform that uses the Kinect sensor to interact with medical video games created specifically as an aid for physical rehabilitation therapies and diagnosis. The sensor used by MIRA comprises an video camera and two monochrome infra-red (IR) sensors of which one is also an IR laser projector, based on which a 3D depth map is created. The Kinect sensor allows recognition of the 3D location of the body joints, thus permitting the MIRA platform to analyse the movement and offer important feedback containing statistics and measurements. The joints that can be tracked are: head, shoulder, elbow, wrist, hand, spine, hip, knee, ankle and foot.[9] Eye-tracking technologies might be considered as a valid tool for enhancing the process of communication to improve the empowerment of persons in childhood and adolescence. The portable eye-controlled communication device Tobii P10, which is an integrated system composed by a screen, an eye control device and a computer.[10]

Information and communication technologies (ICTs) Information and communication technologies (ICTs) comprises of tools in the emerging digital society, characterized by digital informatics, telematics and communications methods. A cerebral palsy child having diminished physical abilities along with the sensory, perceptive, behavioural and cognitive problems need

different types of assistive technology (AT). These assistive technology devices include head trackers, eye control devices, web cams and head pointing devices. Assistive technologies can significantly improve the performance of daily activities, by the use of computers, communication boards which helps in mobility and communication.[11] Different types of technology devices and software are used to improve access in digital world. Few softwares and devices are used for such kind of cerebral palsy children:

Word prediction software displays a small list of the words during typing. Rather than typing every letter of the word, the student can select a whole word with the mouse or by pressing a function key or number on the keyboard. Word prediction can increase the speed of text production and also help writers with poor spelling.

Word bank software displays whole words or phrases on screen, which the user can select using the mouse or by scanning and selecting with a switch. This World Bank software display a corresponding picture and use text-to-speech to help child with poor literacy.

Braille translation software - This can produce text and braille versions. Cerebral palsy students with visual problems can use both braille and standard text printouts. **Scanner with optical character reader (OCR)** is special software used for scanning texts into the computer. The scanned text can be displayed in a larger font, with particular colours, and text-to-speech software can be used to read it.[12] Eye gaze technology is innovative assistive technology to meet the special needs of children in classroom. Eye gaze technology has an potential benefits in children with cerebral palsy. Eye tracking devices or technology that eliminates the need to actually push a button or use a pointer which allows cerebral palsy child to make eye contact with a symbol or letter which is received by the device in same manner as it would have been with a physical point.[13] The iPhone 3GS assist cerebral palsy children having physical, visual or hearing impairments This phone includes features of closed captioning and TTY support, voice control for making calls and voice over for gesture based screen reader.[14] Most cerebral palsy children not able to use the standard 'QWERTY' keyboard and mouse provided within computer. Identifying ICT needs cannot be successful without recognizing and understanding the cognitive abilities of the cerebral palsy child. Pupils with severe and profound difficulties should have diagnostically detailed assessments of their cognitive abilities in place by the time they start school and preferably, before ICT is introduced. ICT can be successfully used as a supportive diagnostic tool within the cognitive assessment process itself.[15]

Conclusion: Recent technology devices provide children with cerebral palsy the opportunity to enjoy life independently. Devices are available in various shapes and sizes to ensure that every child with cerebral palsy is able to receive the assistance in home and school environment.

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