The Role of Virtual Reality Technique on Children with Cerebrl Palsy: A Review article

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Abstract: This review article aimed to identify the effectiveness of Virtual Reality Technique on children affected by Cerebral Palsy. **Methods**: electronic database were searched for experimental trials of Virtual Reality on children with cerebral palsy. **Results**: The study revealed that applied V.R intervention come with many advantages specially on improving upper extremity function, walking and balance ability and used this intervention increased recently due to development in technology and easy accessible and less expensive for children to participate.

Keywords: Virtual Reality-Cerebral Palsy. Video games, Rehabilitation

Introduction:

Cerebral Palsy (C.P) is a non-progressive neuro developmental disorder that affected brain in early childhood and continuing through lifetime*(Gagliardi et al., 2018)*.In addition, C.P become one of the most common motor disorder of childhood , However C.P clinically categorized as spastic, ataxic, athetoid, hypotonic as well as unilateral ,bilateral according to body parts affected(Şahin et al., 2020) .However this disorder characterized by motor and sensory impairments and often accompany with cognition, behavior and epilepsy (Rathinam et al., 2019).

Presently C.P mainly managed by consists of physical therapy in early childhood through preadolescence composed with variety of medical and surgical modalities ,these modalities aim to improve child physical status and decrease future complications or disabilities(Gagliardi et al., 2018) .
It has been demonstrated that C.P doesn't have a cure but rehabilitation depend on different therapies technique such as adaptive devices and education methods for care giver which are helpful in maintaining independent, functional and participation(Snider et al., 2010).

Virtual Reality VR:

V.R is a computer technology that generate virtual settings and items in order to interactions with users(Demers et al., 2021). In addition VR was applied in to rehabilitation field in the 1990s and it is still in the development area as a therapy technique for children with C.P*(Şahin et al., 2020)*. Several studies has
Been demonstrated, that technology offers an alternative interference package for assisting to deal with dysfunction problems in children with C.P*(Chen et al., 2007)*.

According to *(Monge Pereira et al., 2014)* V.R systems can be divided to 3 main programmes depending on the type of human-computer communication: gesture-based, feedback- focused and heptic-pased or based on touch, However, users inter relate with Virtual items by handling and manipulating in a way that creates a sense of virtual presence communicating, computer game which is defined as any type of computer play or virtual realign technology where the child can play and interfere with virtual items in a computer-generated location*(Weiss et al., 2014)*.

Generally, using VR system make clinicians able to control tasks duration and intensity, on the same time V.R provided significant learning experiences by offers motivation and encouragement during rehabilitation process (Fandim et al., 2021)

1 impact of VR on children with C.P

Several studies suggested that in order to achieve productive outcomes, sustainability and repletion are essential in rehabilitation process for children with C.P, these are hard to gain because of children's lifetime due to a number of obstacles such as distance and cost which affect availability to physiotherapy centres, Moreover repletion exercises for a long period may decrease children motivation and enthusiasm, Therefore inserting Virtual Reality therapy for C.P children neurorehabilitation come with a number with advantages like creates enjoyable, meaningful tasks and gives feeling of presence and immersion and consider accessible and less expensive (Tobaiqi et al., 2023)

1.1 Impact on neuro motor control:

Studies estimated that Children with C.P faced problems with neuromuscular functions, this impairment can be seen especially in Spastic c.p which consider as 65-70% of all c.p cases, this impairment called dyskinesia "sensory motor control dysfunction which often implicated in fine motor functions as grasping and reaching activities*(Yoo et al., 2014)*.

According to*(Weiss et al., 2014)*the use of VR in children rehabilitation relays on its characteristic features that offer environmentally effective opportunities.in addition VR system may vary by degree of severity and type of cerebral palsy also its effect rely on quality, availability of the system and the support of therapist and caregiver(Tobaiqi et al., 2023).

Current Knoledge, showed a strong evidence of positive treatment effect in terms of maintain arm movements, balance control for hemiplegic spastic cp children and increasing ankle range of motion, on the other hand literature reported vr exercise system was more enjoyment comparing to convention physiotherapy exercises and it has a long term of benefits outcome specially on hand functions and motor control (Weiss et al., 2014).

1.2 Effect of VR on walking ability:

according to (Gagliardi et al., 2018) the main focus of motor rehabilitation is increasing motor skills to develop child's ability in meaningful activity, in addition traditional

techniques encourage repetition as the essential way, but absence of enthusiasm due to repletion is the frequent basis of drop out and decrees of efficacy of the therapy.

A study conducted by(Gagliardi et al., 2018) demonstrated the effect of used VR technology to study the walking patterns, walking speed, endurance as well as kinematics and kinetics for children with C.P, they found significant improvements for Virtual Reality intervention on walking ability and gait patterns. children in this study experienced 4 weeks training program with 1 daily session for 30 min,5 days a week for a total 18 rehabilitation session on a GRAIL system is a platform which participates a treadmill on a movement frame a vison motion-capture system plus 180 cylindrical projection screen, the all program controlled by a software called D-flow which manages the connection between the item, setup and the communication feedback and stimulations, furthermore, therapy technique applied by GRAIL VR aimed to improve balance and gait activates by following designed exercise program that include (weight shift from right side to left side to avoid obstacles, kick balls at targets inside goals as well as kick as many elves as possible by squatting.

1.3 Impact of VR on balance control:

It's a well-known fact that Balance control is a one of basic fundamentals for motor development in children, so it is improving center of gravity at the supporting level during moving, standing and organising of movement which reflect as difficult ability of a person, however voluntary motion to the center of gravity in order to producing movement in the anterior, posterior and lateral directions(Pourazar et al., 2021).

Virtual.Reality intervention maintain cortical neuroplasticity changes by improved the activation of specific brain areas responsible for motor control reflected in better balance score(Pourazar et al., 2021)

Methodology:

Specific key words related on the role of V.R Technique on children with Cerebral Palsy (CP) on electrical data base including, Google scholar PubMed, and Science Direct (from 2010-2024), research was undertaken for the following keywords and phrases: *Virtual Reality, Cerebral Palsy, virtual Technique and Rehabilitation approach* . Studies that did not focus on the role of Virtual reality were excluded because the purpose of this study was to determine the role of VR as a rehabilitation technique on CP children.

This study did not review the articles which were not published in English, Scientific Journal articles which did not focus on VR rehabilitation technique benefits were also excluded. The study must have mention VR as an interventions training technique for children with CP and should have potential explaination of the mechanism method in ration to positive impac

Results:

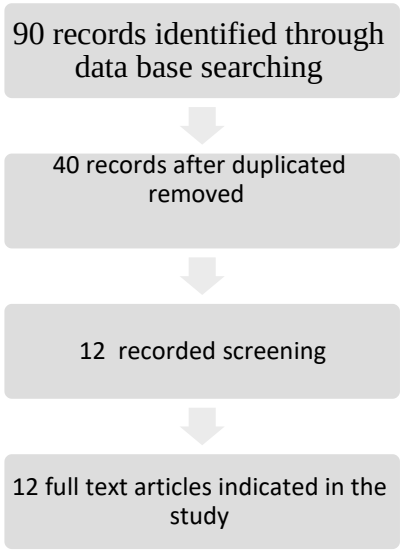

Fig.1 Preferred Reporting Items for review study

Author	Intervention
(Tobaiqi et al.,2023)	Virtual Reality
(Fandim et al., 2021)	Virtual Reality
(Rathinam et al., 2019)	Virtual Reality
(Shin et al., 2015)	Virtual Reality
(Yoo et al., 2014)	Innovative Virtual Reality
(Gagliardi et al., 2018)	Immersive Virtual Reality
(Demers et al., 2021)	Virtual Reality
(Arnoni et al., 2021)	virtual Reality
(Weiss et al., 2014)	Virtual Reality
(Shin et al., 2015)	Virtual Reality
(Monge Pereira et al., 2014)	Virtual Reality

Fig.2 studies including in the review

Discussion:

Recently computer technology has become popular among children and youth with or without disabilities, it increasingly used worldwide .intact approximately one in 4 children own a video game, Inadddition , children and adolescence are familiar with this kind of technology as it could be tool of leisure and a method of socialization , furthermore VR system has some benefits when used to facilitate motor and sensory function for children with cp , literature reported that vr could promote body control and helping maintaining children independent and confidence(Snider et al., 2010).

Shin et al 2015(Shin et al., 2015) examined the impact of VR on eye hand coordination in children with diplegic c.p, their study consist of 16 children who were classified to 1-3 on Cross Motor Function Classification System GMFCS, they divided into two groups children in control group n (8) have underwent of exercise program for 45 minutes for the session for 8 weeks in constraint the children in group study V.R group participated V.R therapy plus basic exercise program, for 45 min of Nintend Wii game , the traditional exercise program consists of exercises focused in strength the upper extremity such as hitting goal used one or both hands during sitting in a posture, moving in directions according to instructions and other ex .researches found after posttest evaluation a significant improvement in VRG comparing to SG ,by applied VR the maintained eye hand coordination and visual motor speed.

A study conducted by Amoni at al 2021(Arnoni et al., 2021) to investigate role of vr on functional mobility and gait, researchers found strong evidence of the effect of VR in peak extension of knee and hip joints researches suggested that using VR technology improved endurance ,mobility ,balance and coordination in children with C.P .

However, another study by (Sharan et al., 2012) conducted to evaluate use of Nintendo Wii sport and Wii fit which used for VR based training (VRBT) The two games allow children to practice sports such as Tennis, Golf , boxing and other sports after that physiotherapists evaluated children depend on their needs and capabilities, the outcome measured by Manual Ability Classification system (MACS) for upper limb function, and Pediatric balance score (PBS), both scales were evaluate children before and after VR therapy , statistical analysis demonstrated a significant improvement on balance score although results were not significant on MACS.

Concluding remarks:

VR has become more common and less expensive as a therapy technique it has progressively more popular for physiotherapists in clinical, hospitals and rehabilitation

centers and that happens because of massive technology advanced of VR systems including recent developments in simplified simulation techniques.so The review article supports the findings that VR may have significant benefits on physical level especialy for both balance and walking ability on children with CP as well as maintain fine motor skills by improving hand function and eye hand coordination.

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