Revista
Coleta Científica
ISSN: 2763-6496

**Scientific Collection Magazine,** Year V, Vol. V, n.10, jul.-dec., 2021

**ISSN: 2763-6496**

**DOI: 10.5281/zenodo.5784211**

# Game therapy in the rehabilitation of patients with cerebral palsy

## Gameterapia na reabilitação de pacientes com paralisia cerebral

Received: 09/19/2021 | Accepted: 12/15/2021 | Published: 12/20/2021

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***Abstract***
*Cerebral palsy (CP) involves motor deficits often related to sensory and cognitive dysfunctions, grouping of a non-progressive brain injury. Gameterapy represents daily life through technology stimulating a neuropsychomotor response, as it is an innovative therapy, performed in a playful way. Virtual Reality (VR) has been used as an accessible therapy for patients with neurological injury and is considered a three-dimensional alternative, through devices that simulate activities that can be performed in the patient's daily life. The objective of the study was to carry out a bibliographic review on the benefits of using technologies called gameterapy and VR in improving the balance of patients with CP. Research was conducted in electronic databases, and 321 articles were found, of which 4 were duplicated in two of the databases, 310 were excluded because they did not present in their methodologies proposals for care using VR and/or gametherapy for the treatment of patients. balance deficits in CP, REVISTA INSPIRAR movimento & saúde Edição 20 | Número 4 OUT/NOV/DEZ | 2020 - 3 - so 11 articles were included in this study. From this bibliographic review, it was verified the effectiveness in the use of VR and gametherapy in the treatment of those requested with CP to improve balance. Because it is a more fun and lucid therapy, patients feel motivated to make a proposal, so this tool adds to traditional physiotherapy to improve balance in CP. It is suggested to carry out new studies with a larger number of participants and with well-defined methodologies.*

***Keywords:*** *Virtual Reality. Physiotherapy. Balance. Cerebral Palsy. Video games*

**Resumo**
A paralisia cerebral (PC) envolve déficits motores frequentemente relacionados a disfunções sensoriais e cognitivas, resultantes de uma lesão encefálica não progressiva. A gameterapia representa a vida diária através da tecnologia estimulando uma resposta neuropsicomotora, por se tratar de uma terapia

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inovadora, realizada de maneira lúdica. A Realidade virtual (RV), vem sendo utilizada como terapia acessível para os pacientes com lesão neurológica sendo considerada uma alternativa tridimensional, através de dispositivos que simulam atividades que possam ser realizados no dia-a-dia do paciente. O Objetivo do estudo foi realizar uma revisão bibliográfica sobre os benefícios da utilização de tecnologias terapêuticas denominadas de gameterapia e realidade virutal na melhora do equilíbrio de pacientes com PC. Foi realizada pesquisa em bases de dados eletrônicas, e foram encontrados 321 artigos, sendo que 4 deles se duplicavam em duas das bases de dados, 310 foram excluídos por não apresentarem em suas metodologias propostas de atendimento utilizando RV e/ou gameterapia para o tratamento dos déficits de equilíbrio na PC, portanto 11 artigos foram incluídos neste estudo. A partir desta revisão bibliográfica, verificou-se efetividade na utilização da RV e gameterapia no tratamento dos indivíduos com PC para a melhora do equilíbrio. Por tratar-se de uma terapia mais divertida e lúcida os pacientes se sentem motivados a realizar a atividade proposta, sendo assim está ferramenta agrega na fisioterapia tradicional para a melhora do equilíbrio na PC. Sugere-se a realização de novos estudos que apresentem maior número de participantes e com metodologias bem descritas.

**Palavras-chaves:** Realidade Virtual. Fisioterapia. Equilíbrio. Paralisia Cerebral. videojogos.

**Introduction.**

Cerebral palsy (CP) is the term used to describe disorders involving motor deficits often related to sensory and cognitive dysfunction, resulting from a non-progressive lesion. This lesion ends up triggering an alteration in the growth of the brain, which affects the development and structural and functional maturation of the central nervous system, and may occur in the prenatal, perinatal or postnatal period1,2,3. In the North American continent, the frequency of CP patients is between 1.5 and 5.9/1,000 live births.4,5 In developing countries, such as Brazil, it is estimated that the incidence of CP is 7 per 1,000 live births.6 The causal factors of CP are diverse, highlighting complications in the gestational period, nutritional deficits, lack of hospital resources and inappropriate care, among several other causal factors 4,5.

Among the various dysfunctions caused by neuronal damage, the posture and movement of this child are often affected, but there may also be visual deficits , epilepsy, malnutrition, cognitive, behavioral, linguistic and cognitive alterations. individual, being topographically classified individually. It is differentiated through modification of muscle tone and in the disordered mode of movement, classified as spastic , dyskinetic, athetoid , ataxic , hypotonic or mixed.8 The Gross Motor Function Measurement (GMFM) scale is used to quantitatively classify changes in activity. gross motor.

It is applied to children with CP, aged between zero and five years, or to children over five years of age who present delays in their motor functionality. The GMFM assessment consists of 66 items that are tested, subdivided into five

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categories: A) lie down and roll over; B) sit; C) crawling and kneeling; D) standing; and E ) walking, running and jumping.9 The Gross Motor Function Classification System (GMFCS) is an identification set divided into five grades. Level I covers children and young people who walk without limitation; II difficulties to cover long distances and balance; III uses mobility aids (such as walkers, crutches and canes); IV requires the use of a wheelchair for locomotion (manual or motorized); V needs totally dependent assistance.10 When performing a physical therapy assessment using the GMFM and GMFCS scales, specific objectives and conducts can be traced for an effective treatment, based on the results obtained with the application of these scales.

Distinctions between the levels of motor function of individuals with CP are based on functional limitations, the need for assistive technology, including mobility aids (such as walkers, crutches, and canes) and wheelchairs, and, to a lesser extent, the quality of movement. Level I includes children with neuromotor dysfunction whose functional limitations are less than those normally associated with CP, who are traditionally diagnosed with “minimum-severity cerebral dysfunction”. The distinctions between Levels I and II are not as clear as the distinctions between the other levels, especially for children under two years of age.

Physiotherapeutic treatment has as its fundamental objectives the reduction of spasticity, increasing muscle strength and range of motion (ROM), aiming at improving the motor condition and functionality of patients with CP. Treatment should be performed in a playful and individualized way, as each patient will respond differently. The physical therapist has several methods that can collaborate in the treatment of patients with CP, such as: kinesiotherapy, Neuroevolutive method Bobath , electrostimulation (FES), hippotherapy , hydrotherapy, elastic garments, use of interactive digital games, among others. The inclusion of gametherapy has been used in the treatment of neurological patients, the target audience is diverse, as this method of therapy can be applied to children, young people, adults and the elderly, thus obtaining positive responses. The use of this device has been evaluated as an important alternative, being pleasant and attractive, in which it will have to improve its performance at each session.

Gametherapy can represent daily life situations through technology, consequently bringing a neuropsychomotor response . Through the welcoming space, the patient performs the activity without realizing it, thus performing the proposed treatment. In the 1950s, after the Second World War, due to technological advances resulting from the War and through new projects to simulate the reality of flights in aeronautics, virtual reality was established as a technology widely used in several other sectors. Its use in leisure was then started and, consequently, it was observed that virtual games could also be used in the treatment of neurological patients, offering the patient playfulness in carrying out the proposed activities.

Virtual Reality (VR) can be an innovative instrument for the practice of activities, being an accessible way for patients who have had a neurological injury, as well as VR can be characterized as a three-dimensional alternative, through devices that represent environments in a real way, which allows the individual to interact through sensory pathways. The use of VR has many benefits, such as: with the

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alternative of adapting the virtual space, which can assist in the therapeutic goals, providing a suitable place for the activity, thus reducing possible bruises, facilitating dialogue, improving its performance, and enabling the progression in the levels of difficulty of the proposed activities. The literature brings two device options, named as virtual reality and game therapy , where VR the patient is immersed in the game, using instruments such as glasses, headphones and/or helmet, in which the individual has the perception of being “inside the game”, having a three-dimensional view of the scenario.

Gametherapy is considered an immersion method, in this way the game is projected through an electronic device in which it is transmitted to a screen, so the individual will have a vision of a virtual doll (called avatar ), where it will play the game commands and the movements performed by the individual who is playing (these movements are captured by a sensor attached to the video game). The objective of this work is to carry out a literature review on the benefits of using therapeutic technologies called gametherapy and virtual reality in improving balance in individuals with CP. It is of great importance to identify whether the uses of these resources help in the treatment and whether they can be considered as effective alternatives in the rehabilitation of these individuals.

**Game therapy in the rehabilitation of patients with cerebral palsy**

The discernment of the pathophysiology of cerebral palsy and its neuropsychomotor consequence are important factors to make it possible to evaluate and design a more reliable treatment for the improvement of these individuals. In this way, the understanding of the disease and its aspects allows the physiotherapy professional to perform an adequate diagnosis, taking into account their motor deficits and their implications and consequently being able to outline personalized physiotherapeutic goals for each case and then the choice of the best therapeutic approaches. .

The physical therapy practice based on scientific evidence is gaining a large space in the day-to-day of professionals, being called evidence-based physical therapy. That is why it is of great importance to carry out new scientific research to improve knowledge of new techniques and ensure quality and effective care for children with CP. According to topographic classification, children with CP can be classified as diplegic , quadriplegic or hemiplegia, and according to REVISTA INSPIRAR moviment & health Issue 20 | Number 4 OCT/NOV/DEC | 2020 - 12 - their motor type are characterized as spastic , dyskinetic, athetoid , ataxic , hypotonic or mixed.

Most of the analyzed studies brought children with hemiplegic23,27,32,33 and diplegic,23,24,29,27 CP with the motor type characterized as spastic.24,29,25,32,33 and with the level of GMFCS I and II, thus classified as mild and moderate, consequently the proposed physiotherapeutic treatments brought more beneficial results for these types of patients, it is worth mentioning that the more severe types also improve, but not with so much scientific evidence. Therefore, it is of great importance to carry out a complete and reliable physiotherapeutic evaluation with each case individually so that the physiotherapeutic goals and conducts are effective.

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Among the forms of motor and balance assessment for this population, the most cited among the articles reviewed were the GMFCS scale23,26,27,29,31,33, which was widely used because it is a validated and sensitive tool for assessing changes motor in the CP after the use of VR; the GMFM8824,26,33 scale, which is a tool used to quantify gross motor functionality, and the Berg Scale25,26 specifically for assessing static and dynamic balance.

The studies analyzed for use in this research are: clinical trials23,26-30 and pilot study.24,25 The clinical trials were divided into: two randomized controlled trials,27,29,31,32 one randomized crossover,23 two experimental studies,28 ,30 a prospective longitudinal study.26 and a prospective, controlled, randomized study31. Thus, the results obtained positive responses, for the gain of balance. All studies analyzed aimed to improve the balance of patients, using VR and gametherapy , and these purposes were achieved.

The therapy time in the analyzed articles varied on average from 20-30 minutes each session, but the study by Meys (2015)25 showed a duration of care of 4 hours and 30 minutes in the experimental group, above the average used in the others, this time way for having been submitted to REVISTA INSPIRAR movement & health Issue 20 | Number 4 OCT/NOV/DEC | 2020 - 13 - 30min complementary VR, the group had a significant improvement, some studies show that consultations lasting 30 minutes25,27,29, showed a significant improvement after the training, as it was carried out in an appropriate place and with supervision of a professional. However, the study by Ramstrand et al. (2012)23 was also performed for 30 minutes, but there is no exact proof whether the patients perform the activity for the specified time, as there was no therapist supervision.

The number of sessions showed little difference between the authors surveyed, varying between 1 and 3 sessions per week and around 15 to 24 sessions in total. The interventions were carried out in spaces suitable for the use of games, and 8 of the 11 studies reported having the physical therapist follow-up during the proposed activity24-30, however, in the study by Ramstrand et al. (2012)23 the participants took the equipment home, so there was no reliable result, as there was no proof of the time and type of game chosen by the patients.

Regarding the types of video games used, some authors used the Xbox 36030,33 in their methodologies, and Sahin (2019)32 used only virtual reality (immersed in the game), the other studies used the Nintendo Wii23-25,26,29 . Sharan et al. (2018)30 compared the use of Xbox 360 and Nintendo Wii and concluded that both had beneficial results for balance gain, but the group that used Xbox 360 reported having a more realistic perception, comparing ADLs . The study by Okmen (2019)31, brought the PlayStation 2 as a virtual reality alternative adapting the video game with a camera connected to the TV, thus making the treatment more accessible. The games used were geared towards sports (tennis, volleyball, basketball, among others). Thus obtaining a satisfactory result in improving the balance of the participants.

According to the author Sahin (2019) 32 , virtual reality was used through a Kinect coupled to a computer that transmitted the game to a television, it showed a considerable improvement in relation to gross and fine motor function, and in

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activities of daily living. INSPIRAR MAGAZINE movement & health Issue 20 | Number 4 OCT/NOV/DEC | 2020 - 14 - Among the games used, were performed by Wii-Fit®23,26,27,29 Snowboard games (ski)29,, Penguin Slide (penguin)29, Super hula Hoop (aerobics and balance)29, Slalom Skiing (skiing)27, Tightrope (rope walking)27, Tilt Table -Balance Board (guiding balls in the holes)27, Heading (hit the ball with the head).27 On the Xbox 360 the games used were: Aerial Challenge (Parachute Jump), Boxing Coach (Fight), Wall Break ( Similar to the tennis game, you have to break as many walls as possible), Jet Run (Running, jumping), Super Chute (penalties)32 , Aventures: 20,000 Leaks (Game that takes place at the bottom of the sea, in which the avatar is inside a glass box, the objective is to cover the holes to prevent water from entering), Space Pop (performs movements with the body to hit the bubbles), River Rush (Game takes place in a stream where the avatar remains inside a boat, it must move along the way and collect the coins) and Reflex Ridge (The game takes place on a train track, and the avatar must dodge obstacles and collect coins).32 Games such as: Still24, Test Your limit24, Follow were used through a computer24,26,27. that paddle24 (Paddle game), Wipeout25 (Running games with obstacles), Airplane25 (Airplane game), Hit-theboxes25 (Box), only one study that compared the Nintendo Wii and Xbox 36030, however some of the articles did not specify the games used23,28,30. Regarding the findings, the method used for rehabilitation through VR technology and gametherapy , for patients with CP, it was observed that this population obtained a significant improvement in several motor aspects, mainly in the improvement of dynamic balance, as it is an innovative instrument. , where individuals felt motivated to perform the proposed activity.

It is worth mentioning that conventional physiotherapy should not be replaced by gametherapy , but rather be used as a complement in sessions, as it is performed in the most fun way where the patient feels most enthusiastic about performing physiotherapy. In this way bringing more benefit to the patient, as a result of this therapy the individual becomes more functional to perform their ADL's, because through the games they perform certain movements similar to those they perform in their day-to-day.

## Final considerations

From this study, there was a positive influence of the use of games such as VR and gametherapy in improving the balance of individuals with cerebral palsy. It is believed that, as it is a more playful therapy, patients with CP feel motivated to perform the proposed activities. Thus, game therapy can be considered a complementary resource in traditional physical therapy, in which most studies have achieved satisfactory results for improving balance in this population. In this way, giving autonomy, and developing an improvement in the quality of daily life. However, few studies with high methodological quality were found that show the importance of complementing physical therapy with games. In addition, many of the articles analyzed do not clearly show the difference between VR and game therapy . Therefore, it is suggested to carry out new studies that present a greater number of participants and with better described methodologies.

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