



Case Report

Effectiveness of Action Observation Therapy in Brachial Plexus Stupor

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Abstract

Introduction: Mirror neurons are the basis of a rehabilitation technique called “*action observation therapy*” (AOT). The observation and imitation of actions performed by people to stimulate brain and facilitate the learning and recovery of motor functions.

Case Report: 45-year-old Caucasian man presented with right brachial plexus stupor after injury. For the functional rehabilitation of an injured body segment we used exergames, i.e. the combination of “*exercise*” and “*game*” of which the NintendoWii is the prototype with conventional physiotherapy for the upper limb post post traumatic nerve injury. Nintendo Wii demonstrate, the activation of “*mirror neurons*”.

The **aim** of this paper on AOT for Peripheral Nervous System (PNS) palsy is to see if this method effectively boosts rehabilitation outcome, especially in brachial plexus stupor.

Conclusion: the results imply that Nintendo Wii therapy integrated with conventional rehabilitation may aid additional benefits on hand functions in peripheral nerve injury.

Keywords: Action observation therapy (AOT); Nintendo Wii; Peripheral Nervous System (PNS)

Introduction

Mirror neurons are located throughout the different areas of the cerebral cortex, the premotor cortex, the supplementary motor area, the primary somatosensory cortex, and the inferior parietal cortex.

Mirror neurons are a special type of neurons that fire both when a person performs an action and when he observes the same action performed by another.

Mirror neurons may be the basis of the rehabilitation technique called “*action observation therapy*” (AOT). It is known that frequent use of a specific body part increases the extension of the cortical representation of that body part [1].

AOT is a rehabilitation approach that uses the mirror neuron system to promote motor and functional recovery in particular in post-stroke patients. During AOT session patient observes videos or people performing specific actions, and this observation improves movement planning and neuroplasticity.

For the functional neuromotor recovery of an injured body segment we used exergames, i.e. the combination of “*exercise*” and “*game*” of which the NintendoWii is the prototype [2]. NintendoWii allowed the patient to carry out the exercises with greater awareness [3] Nintendo Wii demonstrate, the activation of “*mirror neurons*”.

The aim of this paper on AOT for Peripheral Nervous System (PNS) palsy is to see if this technique effectively boosts rehabilitation outcome, especially in brachial plexus stupor.

Case Report

45 year old caucasian man presented with right brachial plexus stupor after injury.

He was admitted to Rehabilitation Unit, don Gnocchi Foundation, in the period June 2025 and September 2025.

The clinical evaluation of patient revealed severe brachial paralysis and a state of unresponsiveness “*stupor*” affecting his right arm post traumatic injury on 07/27/2024. Clinical signs including paralyzed arm, lack of hand/wrist control, numbness, tingling, muscle atrophy, inability to lift wrist (wrist drop), and potentially stiff joints.

The Electromyographic study highlighted severe lesion in the territory of the lateral and posterior cord of the right brachial plexus. Acute neurogenic damage occurred at the level of the radial, axillary and musculocutaneous nerve. On needle examination we observed the presence of denervation activity in the deltoid, common extensor digitorum, and biceps brachial right muscles and the absence of voluntary recruitment of motor units.

For the functional neuromotor recovery of an injured body segment we used exergames, i.e. the combination of “*exercise*” and “*game*” of which the NintendoWii is the prototype integrated with conventional physiotherapy for the upper limb post traumatic nerve injury.

Inside the Wii Sports Resort the player can juggle between twelve different sports disciplines: Archery - Rowing - Frisbee - Chambara - Basketball - Table Tennis - Cycling - Sports at altitude - Wakeboarding - Motorcycle surfing - Golf - Bowling.

The rehabilitation exercise program included sports which, starting from a reduced level of difficulty, determined the activation of mirror neurons by increasing the complexity of the exercises.

Two sporting activities were chosen in Individual Rehabilitation Program (PRI) of case report: bowling and table tennis.

Bowling allowed the patient to carry out movements with a posterior-anterior direction aimed at reaching the midline through the use of the respective upper limb. Bowling has three different levels of complexity: 10-pin bowling, 100-pin bowling and 10-pin bowling with obstacles to avoid.

Table Tennis allowed you to hit the ball with a “*forehand*” or “*backhand*” shot for greater joint stress on the wrist such that it could reduce the forced flexion of the hand.

Functional assessments of the patient were carried out in the short, medium and long term of the PRI.

Baseline assessment conducted at the start of PRI, patient showed

non-functional movement in the main muscle groups of the right upper limb due to peripheral nerve damage. He was unable to voluntarily move his right hand and reported the complete loss of feeling in the arm, including the shoulder and hand.

Final evaluation: The patient was aware of the voluntary motor control of the right upper limb and was able to partially activate the small muscles of the hand.

Case report practiced Nintendo Wii therapy for 3 months (45 minutes/day, 3 times/week) (Figure 1).

The SF-36 questionnaire [4] was administered at the beginning and at the end of rehabilitation sessions.



Figure 1: Patient during a table tennis session.

Discussion

Rehabilitation for peripheral brachial palsy (lesion of the brachial plexus or peripheral nerves of the upper limb) is a long and multidisciplinary process. The possibility of sensory and motor recovery depends on the severity of the lesion (neurapraxia, axonotmesis, neurotmesis), the patient’s age and whether surgery was necessary.

Comparative studies conducted on many animal species have concluded that the basic function of the mirror mechanism is to understand the actions of others simply by observing them, and this also holds true in humans. The “*mirror mechanism*” underlies this congruence between observation and execution, which is

called the “*ideomotor mechanism*” and is the basis of imitation [5].

For the functional neuromotor recovery of an injured body segment we used exergames, i.e. the combination of “*exercise*” and “*game*” of which the NintendoWii is the prototype. NintendoWii allowed the patient to carry out the exercises with greater awareness and to discuss recovery directly with the physiotherapist.

Mirror therapy provides a visual illusion of the affected limb moving normally, stimulating the brain to encourage recovery, while exergames, virtual therapy (Virtual Reality mirror therapy or VRMT) create a realistic, three-dimensional experience of movement to achieve the same goal.

Patient can pick up a joy (Figure 2) controller and compete, moving through the real world in seven action-packed sports. Two sporting activities: bowling and table tennis. were chosen in PRI.



Figure 2: Patient can pick up a joy controller.

Case report showed a peripheral neurologic chronic damage after injury.

On the contrary of the central nervous system (CNS) the peripheral nervous system (PNS) has the capacity for self repair and regeneration [6].

The Nintendo Wi has been utilized in rehabilitation program to activate mirror neurons and stimulate cerebral cortex plasticity in

several chronic disease of CNS such as: stroke, Parkinson, multiple sclerosis, or cerebral palsy [7].

S.Kablanoğlu and Authors showed that mirror therapy associated with traditional neuromotor therapy allows for a positive effect on the grip strength of the hand and sensitivity [8].

Taylor, Anastakis and Davis identified morphological and functional alterations in some brain areas correlated to the upper limb peripheral nervous plexus injury. They demonstrated that there is brain plasticity following peripheral nerve lesion. [9] These results provide insight into brain plasticity and structure-function-behavioural relationships following nerve injury.

Based on recent literature Case reported could be the first to examine the effectiveness of the Nintendo Wii for the rehabilitation of patients with PNS pathologies.

Through this study, it is found out that the Nintendo Wii therapy is comparable to conventional therapy and is a good alternative in the improvement of arm control and hand/wrist range of motion, motor performance and strength.

According to Taylor and Authors study Nintendo Wii therapy integrated with conventional rehabilitation may have important therapeutic implications in brain plasticity following peripheral nerve lesion in addition to diseases of CNS.

The SF 36 questionnaire showed an increase in energy, emotion, general health items during PRI [10].

The limitation of this study is represented by the single case.

Results obtained in case reported can be the basis for further reasoning on the effect of Nintendo Wii therapy on PNS diseases.

Conclusion

The results imply that Nintendo Wii therapy integrated with conventional rehabilitation may aid additional benefits on arm and hand functions in peripheral nerve injury. These results demonstrate that mirror therapy can be used in addition to the rehabilitation program of patients with peripheral nerve injury.

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research authorship and/or publication of this article.

Patient Consent

The patient consent was obtained. The study was approved by the

Ethics Committee of our Centre and all patients provided written informed consent before study treatment.

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