The mirror box illusion: visuoproprioceptive interaction and training effects in children with Spastic Hemiparetic Cerebral Palsy

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the aim of the current research project is to investigate the effect of the mirror box illusion on movement performance, neuromuscular activation and proprioception in children with SHCP. The following objectives are: to determine the effect of the...

Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Musculoskeletal and connective tissue disorders congenital
Study type	Observational non invasive

Summary

ID

NL-OMON34769

Source ToetsingOnline

Brief title The mirror box illusion in SHCP

Condition

• Musculoskeletal and connective tissue disorders congenital

Synonym

Hemiplegia, Spastic Hemiparetic Cerebral Palsy

Research involving

Human

Sponsors and support

Primary sponsor: Vrije Universiteit

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Source(s) of monetary or material Support: beurs van de Manchester Metropolitan University

Intervention

Keyword: Cerebral Palsy, Mirror box, Proprioception

Outcome measures

Primary outcome

Experiment 1 *Judging and Matching*: During the judging task, the smallest detectable difference between the two hands will be determined. This smallest detectable difference is the threshold. In the matching task the difference at endpoint position (distance) and the difference in the elbow angle (measured with a goniometer) between both arms will be determined. The threshold of the judging tasks and the differences on the matching tasks will be taken as main study parameters.

Experiment 2 *One-way mirror*: While performing the slit movement, the distance that is covered by the handle will be determined by means of the Optotrak system. This is called the movement deflection. In addition the relative phase will be calculated which indicates the symmetry between the two arms at each moment in time. Moreover, neuromuscular activation (i.e., mean neuromuscular activity, relative durations of eccentric, concentric, and isometric activity) will be measured by means of EMG. The main study parameters for this experiment are the movement deflection during the slit movement for the different conditions (mirror/glass) and the neuromuscular activation in the different conditions.

Experiment 3 *Learning*: The movement deflection of the handle during the slit

movement and the relative phase (measured with the Optotrak system) in the screen condition will be the main study parameters for the pre- and post-measurement. In addition the neuromuscular activation (i.e., mean neuromuscular activity, relative durations of eccentric, concentric, and isometric activity) while performing the slit movement in the screen condition and the error on the proprioceptive tasks (equal to experiment 1) for the preand post-measurement will be taken as main study parameters. Experiments 1, 2 & 3: The scores of the QUEST (Quality of Upper Extremity

Skills Test).

Secondary outcome

Experiment 2: The time it takes before the hypothesized changes in relative

phase and movement deflection are seen after the transition from mirror to

glass or the other way around.

Experiments 1, 2 & 3: The scores of the MACS and the WeeFIM.

Study description

Background summary

Cerebral palsy (CP) is an umbrella term for a group of permanent disorders of movement and posture hampering daily activities.(1) Spastic Hemiparetic Cerebral Palsy (SHCP) is a common form of CP (33%) (1, 2) caused by non-progressive brain damage in one hemisphere of the fetal or infant brain (3) resulting in movement impairments on one side of the body (contralateral to the lesion). Patients with SHCP have an increased muscle tone, reduced strength, and proprioceptive disturbances.(4) A recent method to improve the functionality of the impaired hand is mirror therapy.(5) Ramachandran and Rogers-Ramachandran(6) first described the mirror-box illusion for the treatment of amputees with phantom pain.(6) However, nowadays the application has expanded to stroke patients and patients with complex regional pain syndrome and the majority of the studies show promising results in the recovery of motor function or reduction of pain in the affected limb.(7, 8) It is thought that, by replacing the absent or disturbed visual information of the affected (amputated, paretic etc.) limb with a mirror reflection of the not affected, healthy body side (by use of a mirror), the sensory afferent (visual) information is *normalized*. This *restoration* of the afferent inflow of information, although manipulated, is suggested to be crucial to reverse the negative effects on movement performance and pain experience.(6) Recently, Feltham et al. (9-11) investigated the effects of the mirror box illusion on movement coordination and neuromuscular activation in children with SHCP during a bimanual circle drawing task. It was found that the mirror could reduce the variability of the intermanual coordination and the high EMG intensity that is usually found in CP children. While these results suggest a positive effect of the mirror box illusion on the motor behaviour in children with SHCP, further research is needed in order to investigate its potential application for intervention. Three important unanswered questions trigger our current research: 1) What is the exact working mechanism of the mirror box? This question will be explored by testing the hypothesis that the mirror enhances movement performance by restoring the afferent visual feedback. Further we will examine what happens with movement performance and neuromuscular activation when normal visual feedback is suddenly replaced by mirror feedback. 2) What is the effect of the mirror box illusion on the proprioceptive ability of the impaired hand in children with SHCP? Feltham et al.(9) focused on bimanual coordination and muscle activation but no attention was paid to proprioception which plays an important role in the control of movement. Proprioception is the sensory feedback that contributes to the conscious sensation of movement, posture and segmental posture and is mediated by proprioceptors in the skin, muscles, tendons, ligaments and joint capsules.(12) It is known that during motor learning or skill acquisition process, a shift in reliance from vision to proprioception takes place.(13) In children with SHCP this shift is considerably hampered due to the disturbed proprioception. Therefore, any therapeutic intervention that aims to improve motor function in children with SHCP depends on its effect on proprioception. 3) What is the effect of a short training programme with the mirror box on the movement performance of the impaired arm in children with SHCP? So far, only the immediate effect of the mirror box has been tested in lab studies, using exposure times of approximately 5 minutes. It is expected that longer interventions will shed more light into the potential outcome of the mirror box and its effectiveness as a therapeutic device. Based on these unanswered questions

Study objective

the aim of the current research project is to investigate the effect of the mirror box illusion on movement performance, neuromuscular activation and proprioception in children with SHCP. The following objectives are: to determine the effect of the mirror box illusion on movement performance and neuromuscular activation when seeing the impaired arm and its mirror reflection; to examine the proprioceptive ability in children with SHCP and the

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effect of the mirror box illusion on this ability; to explore the effect of (a perturbation of) the visual feedback on movement performance in children with SHCP; and to investigate the effect of a short mirror box training on movement performance of the impaired hand in children with SHCP.

Study design

The study consists of 3 separate experiments which aim to gain more insight into the effect of the mirror box illusion in children with SHCP and into the working mechanisms of the mirror box illusion. Experiment 1 will focus on the proprioceptive ability of children with SHCP and the effect of the mirror box illusion on this proprioceptive ability. In experiment 2 the effect of a perturbation of the visual feedback on movement coordination and neuromuscular activation will be determined. Finally, in experiment 3 the effect of a short mirror box training on movement coordination, neuromuscular activation and proprioception will be examined.

Study burden and risks

We do not expect any specific risks for the participants. The methods used are non-invasive (mirror box, goniometer, and EMG) and do not represent any particular risk. It will be secured that the mirror and the perspex glass will be well tied. In addition, in case an allergic reaction to the EMG electrodes in noticed, the electrodes will be removed immediately and no EMG measurement will be performed.

Contacts

Public Vrije Universiteit

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Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age

Adolescents (12-15 years) Adolescents (16-17 years) Children (2-11 years)

Inclusion criteria

Clinical diagnosis of Spastic Hemiparetic Cerebral Palsy (SHCP; either left or right hemispheric damage) Age between 10 and 18 years IQ>80

Exclusion criteria

Any neuromuscular disorders other than SHCP Pain in any of the upper extremities Neglect or visual impairments not corrected to normal Parents/guardians and/or child who do not speak Dutch or English well enough to participate

Study design

Design

Study type: Observational non invasiveMasking:Open (masking not used)Control:UncontrolledPrimary purpose:Basic science

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Recruitment

NL	
Recruitment status:	Recruitment stopped
Start date (anticipated):	01-05-2010
Enrollment:	60
Туре:	Actual

Ethics review

Approved WMO	
Date:	24-03-2010
Application type:	First submission
Review commission:	METC Amsterdam UMC

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register CCMO ID NL30632.029.10