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1: Occup Ther Int. 2009 Jun 10. [Epub ahead of print]

FULL TEXT AVAILABLE ONLINE WILEY InterScience

A review of bilateral training for upper extremity hemiparesis.

Stoykov ME, **Corcos D**.

Rehabilitation Institute of Chicago, Chicago, IL.

Upper extremity hemiparesis is the most common post-stroke disability. Longitudinal studies have indicated that 30-66% of stroke survivors do not have full arm function 6 months post-stroke. The current gold standard for treatment of mild post-stroke upper limb impairment is constraint-induced therapy but, because of the inclusion criteria, alternative treatments are needed which target more impaired subjects. Bilateral arm training has been investigated as a potential rehabilitation intervention. Bilateral arm training encompasses a number of methods including: (1) bilateral isokinematic training; (2) mirror therapy using bilateral training; (3) device-driven bilateral training; and (4) bilateral motor priming. Neural mechanisms mediating bilateral training are first reviewed. The key bilateral training studies that have demonstrated evidence of efficacy will then be discussed. Finally, conclusions are drawn concerning clinical implications based on the reviewed literature. Copyright (c) 2009 John Wiley & Sons, Ltd.

PMID: 19517519 [PubMed - as supplied by publisher]

Related articles

- Comparison of Bilateral and Unilateral Training for Upper Extremity [Neurorehabil Neural Repair. 2009]
- Effects of robot-aided bilateral force-induced isokinetic arm traini [Arch Phys Med Rehabil. 2007]
- Fine motor control in adults with and without chronic hemiparesis [Arch Phys Med Rehabil. 2004]
- *Review* Bilateral arm training: why and who benefits? [NeuroRehabilitation. 2008]
- *Review* Systematic literature review of treatment interventions for upper extrer [Occup Ther Int. 2007]

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2: Brain. 2009 Jul;132(Pt 7):1693-710. Epub 2009 Jun 8.

FULL FINAL TEXT OXFORD JOURNALS

The use of visual feedback, in particular mirror visual feedback, in restoring brain function.

Ramachandran VS, **Altschuler EL**.

Center for Brain and Cognition, University of California, San Diego, 9500 Gilman Drive, 0109, La Jolla, California 92093-0109, USA. vramacha@ucsd.edu

This article reviews the potential use of visual feedback, focusing on mirror visual feedback, introduced over 15 years ago, for the treatment of many chronic neurological disorders that have long been regarded as intractable such as phantom pain, hemiparesis from stroke and complex regional pain syndrome. Apart from its clinical importance, mirror visual feedback paves the way for a paradigm shift in the way we approach neurological disorders. Instead of resulting entirely from irreversible damage to specialized brain modules, some of them may arise from short-term functional shifts that are potentially reversible. If so, relatively simple therapies can be devised--of which mirror visual feedback is an example--to restore function.

PMID: 19506071 [PubMed - indexed for MEDLINE]

Related articles

- *Review* Mirror visual feedback for the treatment of complex regional p [Curr Pain Headache Rep. 2008]
- *Review* Plasticity and functional recovery in neurology. [Clin Med. 2005]
- Mirror box therapy for complex regional pain syndrome. [Anaesthesia. 2006]
- *Review* [Mirror feed-back - a new method for the treatment of neurop [Dtsch Med Wochenschr. 2007]
- Graded motor imagery for pathologic pain: a randomized controlled trial. [Neurology. 2006]

» See reviews... | » See all...

3: Disabil Rehabil. 2009 May 20:1-15. [Epub ahead of print]

informaworld

Systematic review of the effectiveness of mirror therapy in upper extremity function.

Ezendam D, **Bongers RM**, **Jannink MJ**.

Center for Human Movement Sciences, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands.

Purpose. This review gives an overview of the current state of research regarding the effectiveness of mirror therapy in upper extremity function. Method. A systematic literature search was performed to identify studies concerning mirror therapy in upper extremity. The included journal articles were reviewed according to a structured diagram and the methodological quality was assessed. Results. Fifteen studies were identified and reviewed. Five different patient categories were studied: two studies focussed on mirror therapy after an amputation of the upper limb, five studies focussed

Related articles

- *Review* A rapid and systematic review of the clinical effectiveness [Health Technol Assess. 2001]
- Mirror Therapy in Complex Regional Pain Syndrome Type [Neurorehabil Neural Repair. 2009]
- Does Cryotherapy Improve Outcomes With Soft Tissue Injury? [J Athl Train. 2004]
- *Review* The measurement and monitoring of surgical adverse eve [Health Technol Assess. 2001]
- *Review* Sensory re-education after nerve injury of the upper limb: a systematic re [Clin Rehabil. 2007]

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on mirror therapy after stroke, five studies focussed on mirror therapy with complex regional pain syndrome type 1 (CRPS1) patients, one study on mirror therapy with complex regional pain syndrome type 2 (CRPS2) and two studies focussed on mirror therapy after hand surgery other than amputation. Conclusions. Most of the evidence for mirror therapy is from studies with weak methodological quality. The present review showed a trend that mirror therapy is effective in upper limb treatment of stroke patients and patients with CRPS, whereas the effectiveness in other patient groups has yet to be determined.

PMID: 19479545 [PubMed - as supplied by publisher]

4: Neurorehabil Neural Repair. 2009 May 22. [Epub ahead of print]

View Full-Text Article at SAGE Publications

Mirror Therapy in Complex Regional Pain Syndrome Type 1 of the Upper Limb in Stroke Patients.

Cacchio A, **De Blasis E**, **De Blasis V**, **Santilli V**, **Spacca G**.

BACKGROUND: Complex regional pain syndrome type 1 (CRPSt1) of the upper limb is a painful and debilitating condition, frequent after stroke, and interferes with the rehabilitative process and outcome. However, treatments used for CRPSt1 of the upper limb are limited. OBJECTIVE: . This randomized controlled study was conducted to compare the effectiveness on pain and upper limb function of mirror therapy on CRPSt1 of upper limb in patients with acute stroke. METHODS: . Of 208 patients with first episode of unilateral stroke admitted to the authors' rehabilitation center, 48 patients with CRPSt1 of the affected upper limb were enrolled in a randomized controlled study, with a 6-month follow-up, and assigned to either a mirror therapy group or placebo control group. The primary end points were a reduction in the visual analogue scale score of pain at rest, on movement, and brush-induced tactile allodynia. The secondary end points were improvement in motor function as assessed by the Wolf Motor Function Test and Motor Activity Log. RESULTS: . The mean scores of both the primary and secondary end points significantly improved in the mirror group ($P < .001$). No statistically significant improvement was observed in any of the control group values ($P > .001$). Moreover, statistically significant differences after treatment ($P < .001$) and at the 6-month follow-up were found between the 2 groups. CONCLUSIONS: . The results indicate that mirror therapy effectively reduces pain and enhances upper limb motor function in stroke patients with upper limb CRPSt1.

PMID: 19465507 [PubMed - as supplied by publisher]

Related articles

- Robotic-assisted rehabilitation of the upper limb after acute stroke. [Arch Phys Med Rehabil. 2007]
- A randomized, double-blind, placebo-controlled study of the efficacy and safety [Eur J Neurol. 2001]
- Computerized arm training improves the motor control of the severely affected arm a [Stroke. 2005]
- *Review* Repetitive task training for improving functional abil [Cochrane Database Syst Rev. 2007]
- *Review* The use of visual feedback, in particular mirror visual feedback, in restoring bra [Brain. 2009]

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5: Ann Phys Rehabil Med. 2009 Apr;52(3):269-93. Epub 2009 Apr 9.

ELSEVIER FULL-TEXT ARTICLE

Rehabilitation of arm function after stroke. Literature review.

[Article in English, French]

Oujamaa L, **Relave I**, **Froger J**, **Mottet D**, **Pelissier JY**.

Unité de rééducation et réadaptation neurologique, département de MPR, hôpital Carémeau, centre médical Le-Grau-du-Roi, Nîmes, France. loujamaa@chu-grenoble.fr

INTRODUCTION: In the recent literature we can find many articles dealing with upper extremity rehabilitation in stroke patients. New techniques, still under evaluation, are becoming the practical applications for the concept of post-stroke brain plasticity. METHODS: This literature review focuses on controlled randomized studies, reviews and meta-analyses published in the English language from 2004 to 2008. The research was conducted in MEDLINE with the following keywords: "upper limb", "stroke", "rehabilitation". RESULTS: We reviewed 66 studies. The main therapeutic strategies are: activation of the ipsilesional motor cortex, inhibition of the contralesional motor cortex and modulation of the sensory afferents. Keeping a cortical representation of the upper limb distal extremity could prevent the learned non-use phenomenon. The modulation of sensory afferents is then proposed: distal cutaneous electrostimulation, anesthesia of the healthy limb, mirror therapy, virtual reality. Intensifying the rehabilitation care means increasing the total hours of rehabilitation dedicated to the paretic limb (proprioceptive stimulation and repetitive movements). This specific rehabilitation is facilitated by robot-aided therapy in the active-assisted mode, neuromuscular electrostimulation and bilateral task training. Intensifying the rehabilitation training program significantly improves the arm function outcome when performed during subacute stroke rehabilitation (< six months). Ipsilesional neurostimulation as well as mental practice optimize the effect of repetitive gestures for slight motor impairments. Contralesional neurostimulation or anesthesia of

Related articles

- *Review* Effects of robot-assisted therapy on upper limb recovery af [Neurorehabil Neural Repair. 2008]
- Repetitive bilateral arm training and motor cortex activation in chronic stroke: a random [JAMA. 2004]
- Construction of efficacious gait and upper limb functional interventior [ScientificWorldJournal. 2007]
- Effects of robot-aided bilateral force-induced isokinetic arm trainii [Arch Phys Med Rehabil. 2007]
- *Review* Repetitive task training for improving functional abil [Cochrane Database Syst Rev. 2007]

» See reviews... | » See all...

the healthy hand both improve the paretic hand's dexterity via a decrease of the transcallosal inhibition. This pathophysiological mechanism could also explain the positive impact of constraint-induced movement therapy (CI therapy) in an environmental setting for chronic stroke patients. CONCLUSION: To ensure a positive functional outcome, stroke rehabilitation programs are based on task-oriented repetitive training. This literature review shows that exercising the hemiparetic hand and wrist is essential in all stages of a stroke rehabilitation program. New data stemming from neurosciences suggest that ipsilesional corticospinal excitability should be a priority.

PMID: 19398398 [PubMed - indexed for MEDLINE]

6: Neurorehabil Neural Repair. 2009 Mar-Apr;23(3):209-17. Epub 2008 Dec 12.

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Comment in:
Neurorehabil Neural Repair. 2009 Mar-Apr;23(3):207-8.

Mirror therapy promotes recovery from severe hemiparesis: a randomized controlled trial.

Dohle C, **Püllen J**, **Nakaten A**, **Küst J**, **Rietz C**, **Karbe H**.

Klinik Berlin, Department of Neurological Rehabilitation, Charite-University Medicine Berlin, Campus Benjamin Franklin, Germany. dohle.berlin@median-kliniken.de

BACKGROUND: . Rehabilitation of the severely affected paretic arm after stroke represents a major challenge, especially in the presence of sensory impairment. OBJECTIVE: . To evaluate the effect of a therapy that includes use of a mirror to simulate the affected upper extremity with the unaffected upper extremity early after stroke. METHODS: . Thirty-six patients with severe hemiparesis because of a first-ever ischemic stroke in the territory of the middle cerebral artery were enrolled, no more than 8 weeks after the stroke. They completed a protocol of 6 weeks of additional therapy (30 minutes a day, 5 days a week), with random assignment to either mirror therapy (MT) or an equivalent control therapy (CT). The MAIN OUTCOME MEASURES: were the Fugl-Meyer subscores for the upper extremity, evaluated by independent raters through videotape. Patients also underwent functional and neuropsychological testing. RESULTS: . In the subgroup of 25 patients with distal plegia at the beginning of the therapy, MT patients regained more distal function than CT patients. Furthermore, across all patients, MT improved recovery of surface sensibility. Neither of these effects depended on the side of the lesioned hemisphere. MT stimulated recovery from hemineglect. CONCLUSIONS: . MT early after stroke is a promising method to improve sensory and attentional deficits and to support motor recovery in a distal plegic limb.

PMID: 19074686 [PubMed - indexed for MEDLINE]

Related articles

- *Review* Effects of robot-assisted therapy on upper limb recovery af [Neurorehabil Neural Repair. 2008]
- Robotic-assisted rehabilitation of the upper limb after acute stroke. [Arch Phys Med Rehabil. 2007]
- Training of reaching in stroke survivors with severe and chronic upper limb paresis using [Stroke. 2008]
- Recovery of motor disability and spasticity in post-stroke after repetitive transcr [Brain Res Bull. 2008]
- *Review* Pediatric CI therapy for stroke-induced hemiparesis in young chil [Dev Neurorehabil. 2007]

» See reviews... | » See all...

7: Curr Pain Headache Rep. 2008 Apr;12(2):103-7.

Mirror visual feedback for the treatment of complex regional pain syndrome (type 1).

McCabe CS, **Haigh RC**, **Blake DR**.

The Royal National Hospital for Rheumatic Diseases, Upper Borough Walls, Bath, BA1 1RL, UK. candy.mccabe@rnhrd.nhs.uk

Mirror visual feedback was originally devised as a therapeutic tool to relieve perceived involuntarily movements and paralysis in the phantom limb. Since this pioneering work was conducted in the mid-1990s, the technique has been applied to relieve pain and enhance movement in other chronic conditions such as stroke and complex regional pain syndrome (CRPS) type 1. This review describes how mirror visual feedback was first developed with amputees, its original application in CRPS, and how further research has demonstrated its potential benefit within graded motor imagery programs. We discuss the potential mechanisms behind this technique and consider the implications for clinical practice.

PMID: 18474189 [PubMed - indexed for MEDLINE]

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- Mirror box therapy for complex regional pain syndrome. [Anaesthesia. 2006]
- Graded motor imagery for pathologic pain: a randomized controlled trial. [Neurology. 2006]
- Is successful rehabilitation of complex regional pain syndrome due to sustained attenti [Pain. 2005]
- *Review* Complex regional pain syndrome: a review. [J Postgrad Med. 2004]

» See reviews... | » See all...

8: Arch Phys Med Rehabil. 2008 Mar;89(3):393-8.

ELSEVIER FULL-TEXT ARTICLE

Mirror therapy improves hand function in subacute stroke: a randomized controlled trial.

Yavuzer G, **Selles R**, **Sezer N**, **Sütbeyaz S**, **Bussmann JB**, **Köseoğlu F**, **Atay MB**, **Stam HJ**.

Related articles

- Mirror therapy enhances lower-extremity motor recovery and motor [Arch Phys Med Rehabil. 2007]
- "Playstation eyetoy games" improve upper extremity-related m [Eur J Phys Rehabil Med. 2008]

Department of Physical Medicine and Rehabilitation, Ankara University Faculty of Medicine, Ankara, Turkey. gyavuzer@medicine.ankara.edu.tr

OBJECTIVE: To evaluate the effects of mirror therapy on upper-extremity motor recovery, spasticity, and hand-related functioning of inpatients with subacute stroke. DESIGN: Randomized, controlled, assessor-blinded, 4-week trial, with follow-up at 6 months. SETTING: Rehabilitation education and research hospital. PARTICIPANTS: A total of 40 inpatients with stroke (mean age, 63.2y), all within 12 months poststroke. INTERVENTIONS: Thirty minutes of mirror therapy program a day consisting of wrist and finger flexion and extension movements or sham therapy in addition to conventional stroke rehabilitation program, 5 days a week, 2 to 5 hours a day, for 4 weeks. MAIN OUTCOME MEASURES: The Brunnstrom stages of motor recovery, spasticity assessed by the Modified Ashworth Scale (MAS), and hand-related functioning (self-care items of the FIM instrument). RESULTS: The scores of the Brunnstrom stages for the hand and upper extremity and the FIM self-care score improved more in the mirror group than in the control group after 4 weeks of treatment (by 0.83, 0.89, and 4.10, respectively; all P<.01) and at the 6-month follow-up (by 0.16, 0.43, and 2.34, respectively; all P<.05). No significant differences were found between the groups for the MAS. CONCLUSIONS: In our group of subacute stroke patients, hand functioning improved more after mirror therapy in addition to a conventional rehabilitation program compared with a control treatment immediately after 4 weeks of treatment and at the 6-month follow-up, whereas mirror therapy did not affect spasticity.

PMID: 18295613 [PubMed - indexed for MEDLINE]

- Robotic-assisted rehabilitation of the upper limb after acute stroke. [Arch Phys Med Rehabil. 2007]
- Review Rehabilitation of arm function after stroke. Literature review. [Ann Phys Rehabil Med. 2009]
- Review Treatment of upper extremity spasticity in stroke patients by focal neurc [J Rehabil Med. 2002]

» See reviews... | » See all...

9: Scand J Plast Reconstr Surg Hand Surg. 2008;42(2):110-1.

informaworld

Mirror therapy in a patient with a fractured wrist and no active wrist extension.

Altschuler EL, **Hu J**.

Department of Physical Medicine and Rehabilitation, University of Medicine and Dentistry of New Jersey, Newark, NJ 07101, USA. eric.altschuler@umdnj.edu

We report a patient in whom mirror therapy, training moving both hands while watching the reflection of the present or good hand in a parasaggital mirror - a method used for phantom limb and stroke patients - was extremely useful after a fractured wrist with good passive, but no active, extension.

PMID: 18335358 [PubMed - indexed for MEDLINE]

Related articles

- The effects of wrist distraction on carpal kinematics. [J Hand Surg Am. 1999]
- Review Management of fractures of the distal radius: therapist's commentary. [J Hand Ther. 1999]
- Early motion in the treatment of fractures and dislocations in the hand and wrist [Hand Clin. 1996]
- Correlation of impairment and activity limitation after wrist fracture. [Physiother Res Int. 2002]
- Review [Physical therapy treatment of distal nbecks Arch Chir Suppl II Verh Dtsch Ges Chir. 1990]

» See reviews... | » See all...

10: Arch Phys Med Rehabil. 2007 May;88(5):555-9.

ELSEVIER FULL-TEXT ARTICLE

Mirror therapy enhances lower-extremity motor recovery and motor functioning after stroke: a randomized controlled trial.

Sütbeyaz S, **Yavuzer G**, **Sezer N**, **Koseoglu BF**.

IVth Physical Medicine and Rehabilitation Clinic, Ankara Physical Medicine and Rehabilitation Education and Research Hospital, Ankara, Turkey.

OBJECTIVE: To evaluate the effects of mirror therapy, using motor imagery training, on lower-extremity motor recovery and motor functioning of patients with subacute stroke. DESIGN: Randomized, controlled, assessor-blinded, 4-week trial, with follow-up at 6 months. SETTING: Rehabilitation education and research hospital. PARTICIPANTS: A total of 40 inpatients with stroke (mean age, 63.5 y), all within 12 months poststroke and without volitional ankle dorsiflexion. INTERVENTIONS: Thirty minutes per day of the mirror therapy program, consisting of nonparetic ankle dorsiflexion movements or sham therapy, in addition to a conventional stroke rehabilitation program, 5 days a week, 2 to 5 hours a day, for 4 weeks. MAIN OUTCOME MEASURES: The Brunnstrom stages of motor recovery, spasticity assessed by the Modified Ashworth Scale (MAS), walking ability (Functional Ambulation Categories [FAC]), and motor functioning (motor items of the FIM instrument). RESULTS: The mean change score and 95% confidence interval (CI) of the Brunnstrom stages (mean, 1.7; 95% CI, 1.2-2.1; vs mean, 0.8; 95% CI, 0.5-1.2; P=.002), as well as the FIM motor score (mean, 21.4; 95% CI, 18.2-24.7; vs mean, 12.5; 95% CI, 9.6-14.8; P=.001) showed significantly more improvement at follow-up in the mirror group compared with the control group. Neither MAS (mean, 0.8; 95% CI, 0.4-1.2; vs mean, 0.3; 95% CI, 0.1-0.7; P=.102) nor FAC (mean, 1.7; 95% CI, 1.2-2.1; vs mean, 1.5; 95% CI, 1.1-1.9; P=.610) showed a significant difference between the groups. CONCLUSIONS: Mirror therapy combined with a conventional stroke rehabilitation program enhances lower-

Related articles

- Mirror therapy improves hand function in subacute stroke: a randomize [Arch Phys Med Rehabil. 2008]
- "Playstation eyetoy games" improve upper extremity-related m [Eur J Phys Rehabil Med. 2008]
- Neuromuscular electric stimulation effect on lower-extremity motor rec [Arch Phys Med Rehabil. 2006]
- Review Repetitive task training for improving functional abil [Cochrane Database Syst Rev. 2007]
- Review Rehabilitation of arm function after stroke. Literature review. [Ann Phys Rehabil Med. 2009]

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- Review Advances in stroke regenerative medicine 2007. [Stroke. 2008]

extremity motor recovery and motor functioning in subacute stroke patients.

PMID: 17466722 [PubMed - indexed for MEDLINE]

11: Neuroimage. 2007;36 Suppl 2:T164-73. Epub 2007 Mar 31.

ELSEVIER FULL-TEXT ARTICLE

Action observation has a positive impact on rehabilitation of motor deficits after stroke.

Ertelt D, **Small S**, **Solodkin A**, **Dettmers C**, **McNamara A**, **Binkofski F**, **Buccino G**.

Department of Neurology and Neuroimage Nord, University Hospital Schleswig-Holstein, Campus Lübeck, Ratzeburger Allee 160, 23538 Lübeck, Germany.

Evidence exists that the observation of actions activates the same cortical motor areas that are involved in the performance of the observed actions. The neural substrate for this is the mirror neuron system. We harness this neuronal system and its ability to re-enact stored motor representations as a means for rehabilitating motor control. We combined observation of daily actions with concomitant physical training of the observed actions in a new neurorehabilitative program (action observation therapy). Eight stroke patients with moderate, chronic motor deficit of the upper limb as a consequence of medial artery infarction participated. A significant improvement of motor functions in the course of a 4-week treatment, as compared to the stable pre-treatment baseline, and compared with a control group have been found. The improvement lasted for at least 8 weeks after the end of the intervention. Additionally, the effects of action observation therapy on the reorganization of the motor system were investigated by functional magnetic resonance imaging (fMRI), using an independent sensorimotor task consisting of object manipulation. The direct comparison of neural activations between experimental and control groups after training with those elicited by the same task before training yielded a significant rise in activity in the bilateral ventral premotor cortex, bilateral superior temporal gyrus, the supplementary motor area (SMA) and the contralateral supramarginal gyrus. Our results provide pieces of evidence that action observation has a positive additional impact on recovery of motor functions after stroke by reactivation of motor areas, which contain the action observation/action execution matching system.

PMID: 17499164 [PubMed - indexed for MEDLINE]

Related articles

- *Review* Functions of the mirror neuron system: implications for neurorel [Cogn Behav Neurol. 2006]
- Neural correlates of proprioceptive integration in the contralesion [Neurorehabil Neural Repair. 2008]
- *Review* Integrated technology for evaluation of brain function [Phys Med Rehabil Clin N Am. 2004]
- Mental practice with motor imagery: evidence for motor recovery and [Arch Phys Med Rehabil. 2006]
- Analysis of fMRI and finger tracking training in subjects with chronic stroke. [Brain. 2002]

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- *Review* Using non-invasive brain stimulation to augment motor training [J Neuroeng Rehabil. 2009]

12: J Rehabil Med. 2007 Jan;39(1):5-13.

Journal of REHABILITATION MEDICINE Full text article

Motor imagery and stroke rehabilitation: a critical discussion.

de Vries S, **Mulder T**.

Centre for Human Movement Sciences, University Medical Centre Groningen, University of Groningen, the Netherlands. s.j.de.vries@rug.nl

Motor disorders are a frequent consequence of stroke and much effort is invested in the re-acquisition of motor control. Although patients often regain some of their lost function after therapy, most remain chronically disabled. Functional recovery is achieved largely through reorganization processes in the damaged brain. Neural reorganization depends on the information provided by sensorimotor efferent-afferent feedback loops. It has, however, been shown that the motor system can also be activated "offline" by imagining (motor imagery) or observing movements. The discovery of mirror neurones, which fire not only when an action is executed, but also when one observes another person performing the same action, also show that our action system can be used "online" as well as offline. It is an intriguing question as to whether the information provided by motor imagery or motor observation can lead to functional recovery and plastic changes in patients after stroke. This article reviews the evidence for motor imagery or observation as novel methods in stroke rehabilitation.

PMID: 17225031 [PubMed - indexed for MEDLINE]

Related articles

- Mental practice with motor imagery: evidence for motor recovery and [Arch Phys Med Rehabil. 2006]
- Does motor imagery training improve hand function in chronic stroke patients? A pi [Clin Rehabil. 2004]
- Clinical assessment of motor imagery after stroke. [Neurorehabil Neural Repair. 2008]
- *Review* Motor imagery and action observation: cognitive tools for rehabilit [J Neural Transm. 2007]
- *Review* Motor imagery: a backdoor to the motor system after stroke? [Stroke. 2006]

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- FMRI brain-computer interface: a tool for neuroscientific resea [Comput Intell Neurosci. 2007]

13: Joint Bone Spine. 2006 Oct;73(5):495-9. Epub 2006 Jun 30.

ELSEVIER FULL-TEXT ARTICLE

Current management of reflex sympathetic dystrophy syndrome (complex regional pain syndrome type I).

Berthelot JM.

Service de rhumatologie, Hôtel-Dieu, CHU de Nantes, 1, place Alexis, Nantes cedex

Related articles

- An open-label pilot trial of ibandronate for complex regional pain syndrome. [Clin J Pain. 2008]
- *Review* [What is the place of diphosphonates in the treatment of cor [Ann Readapt Med Phys. 2005]

01, France. jeanmarie.berthelot@chu-nantes.fr

Although no major advances have occurred in the curative treatment of reflex sympathetic dystrophy syndrome (RSDS), new pathogenic insights may soon lead to innovative approaches, which may also prove effective in alleviating some forms of neuropathic pain. Preventing nerve compression and ischemia-reperfusion injury constitute valuable measures for preventing RSDS. Vitamin C administration can also prevent RSDS, together with clonidine in high-risk patients. Short-term glucocorticoid therapy has been found effective in preventing RSDS after stroke but has not been evaluated in other situations. Beneficial effects of bisphosphonates have been documented in several placebo-controlled trials. Placebo-controlled trials of ketamine and spinal cord stimulation are in order to confirm or refute the promising results obtained in open-label studies. Mirror visual feedback was introduced recently for the rehabilitation of patients with RSDS but needs to be evaluated in randomized controlled trials.

PMID: 16837228 [PubMed - indexed for MEDLINE]

- Review [Treatment of posttraumatic dystrophy] [Ned Tijdschr Geneeskd. 2000]
- Bisphosphonates for RSDS and prostate cancer--more benefit then revealed [Joint Bone Spine. 2002]
- Review Treatment of complex regional pain syndrome type I. [Eur J Pain. 2002]

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- Metastatic gastric cancer presenting with shoulder-hand syndrome: a case [J Med Case Reports. 2008]

Patient Drug Information

- Clonidine (Catapres®, Clorpres® (as a combination product containing Clonidine and Chlorthalidone)) Clonidine is used alone or in combination with

Source: AHFS Consumer Medication Information

14: Perception. 2005;34(9):1153-5.

Interaction of vision and movement via a mirror.

Altschuler EL.

Department of Physical Medicine and Rehabilitation, University of Medicine & Dentistry of New Jersey, Newark 07101, USA. eric.altschuler@umdnj.edu

I have noticed a striking effect that vision can have on movement: when a person makes circular motions with both hands, clockwise with the left hand, counterclockwise with the right hand, while watching the reflection of one hand in a parasagitally placed mirror, if one arm makes a vertical excursion, the other arm tends to make the same vertical excursion, but not typically if the excursing arm is viewed in plain vision. This observation may help in understanding how visual feedback via a mirror may be beneficial for rehabilitation of some patients with movement deficits secondary to certain neurologic conditions, and illustrates that the traditional division of neural processes into sensory input and motor output is somewhat arbitrary.

PMID: 16245491 [PubMed - indexed for MEDLINE]

Related articles

- The effect of target modality on visual and proprioceptive contributions t [Exp Brain Res. 2007]
- Is proprioception calibrated during visually guided movements? [Exp Brain Res. 2005]
- Vision in the palm of your hand. [Neuropsychologia. 2009]
- Review [Perception and regulation of human movement: Plea for a physical bi [J Soc Biol. 2006]
- Review Visual perception and interception of falling objects: a review of evi [J Neural Eng. 2005]

» See reviews... | » See all...

15: Clin Med. 2005 Jul-Aug;5(4):368-73.

Plasticity and functional recovery in neurology.

Ramachandran VS.

Center for Brain and Cognition, University of California at San Diego, La Jolla 92093-0109, USA. vramacha@ucsd.edu

Experiments on patients with phantom limbs suggest that neural connections in the adult human brain are much more malleable than previously assumed. Three weeks after amputation of an arm, sensations from the ipsilateral face are referred to the phantom; this effect is caused by the sensory input from the face skin 'invading' and activating deafferented hand zones in the cortex and thalamus. Many phantom arms are 'paralysed' in a painful position. If a mirror is propped vertically in the sagittal plane and the patient looks at the reflection of his/her normal hand, this reflection appears superimposed on the 'felt' position of the phantom. Remarkably, if the real arm is moved, the phantom is felt to move as well and this sometimes relieves the painful cramps in the phantom. Mirror visual feedback (MVF) has shown promising results with chronic regional pain syndrome and hemiparesis following stroke. These results suggest two reasons for a paradigm shift in neurorehabilitation. First, there appears to be tremendous latent plasticity even in the adult brain. Second, the brain should be thought of, not as a hierarchy of organised autonomous modules, each of which delivers its output to the next level, but as a set of complex interacting networks that are in a state of dynamic equilibrium with the brain's environment. Both principles can be potentially exploited in a clinical context to facilitate recovery of function.

PMID: 16138492 [PubMed - indexed for MEDLINE]

Related articles

- Synaesthesia in phantom limbs induced with mirrors. [Proc Biol Sci. 1996]
- Review The use of visual feedback, in particular mirror visual feedback, in restoring bra [Brain. 2009]
- Doing it with mirrors: a case study of a novel approach to neu [Neurorehabil Neural Repair. 2000]
- A neural substrate for nonpainful phantom limb phenomena. [Neuroreport. 2000]
- Review Upper limb movements and cerebral plasticity in post-stroke [Aging Clin Exp Res. 2008]

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Cited by 1 PubMed Central article

- More than the sum of its parts. Royal Victoria Hospital, Thursday 4th Octobe [Ulster Med J. 2008]

16: Scand J Plast Reconstr Surg Hand Surg. 2005;39(2):104-8.

Training with a mirror in rehabilitation of the hand.

Rosén B, **Lundborg G**.

Department of Hand Surgery, Malmö University Hospital, Malmö, Sweden. birgitta.rosen@hand.mas.lu.se

Treatment with a mirror gives an illusion of function in a missing or non-functioning hand. The method is based on the concept that the central representation of phantoms and body image can change rapidly, and has been described in the treatment of phantom pain and stroke. We show in three pilot cases new applications for the use of the mirror in rehabilitation after hand surgery.

PMID: 16019738 [PubMed - indexed for MEDLINE]

Related articles

- Mirror therapy improves hand function in subacute stroke: a randomize [Arch Phys Med Rehabil. 2008]
- Outcome following conservative treatment of metacarpophalangeal ‹ [J Hand Surg Eur Vol. 2007]
- Speed of finger tapping as a predictor of functional outcome after unilat [Arch Phys Med Rehabil. 2006]
- Review Rehabilitation approaches for distal and middle phalanx fractures of the [J Hand Ther. 2003]
- Review Traumatic simultaneous rupture of both flexor tendons in a finger of an [Am J Orthop. 2005]

» See reviews... | » See all...

17: Exp Brain Res. 2005 May;163(1):118-22. Epub 2005 Mar 8.

Mirror, mirror on the wall: viewing a mirror reflection of unilateral hand movements facilitates ipsilateral M1 excitability.

Garry MI, **Loftus A**, **Summers JJ**.

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Primary motor cortex (M1) excitability is modulated by both ipsilateral limb movement and passive observation of movement of the contralateral limb. An interaction of these effects within M1 may account for recent research suggesting improved functional recovery of the impaired arm following stroke by viewing a mirror reflection of movements of the unimpaired arm superimposed over the (unseen) impaired arm. This hypothesis was tested in the present study using single-pulse transcranial magnetic stimulation (TMS) in eight neurologically healthy subjects. Excitability of M1 ipsilateral to a phasic, unilateral hand movement was measured while subjects performed paced (1 Hz), unilateral index finger-thumb opposition movements. Motor evoked potentials (MEPs) were obtained from the inactive first dorsal interosseous (FDI) in each of four viewing conditions: Active (viewing the active hand), Central (viewing a mark positioned between hands), Inactive (viewing the inactive hand) and Mirror (viewing a mirror-reflection of the active hand in a mirror oriented in the mid-sagittal plane) and with both hands at rest (Rest). MEPs were significantly enhanced during ipsilateral hand movement compared with the Rest condition ($P<0.05$). Largest MEPs were obtained in the Mirror condition, and this was significant compared with both the Inactive and Central viewing conditions ($P<0.05$). There was no difference between the dominant and non-dominant hand. Excitability of M1 ipsilateral to a unilateral hand movement is facilitated by viewing a mirror reflection of the moving hand. This finding provides neurophysiological evidence supporting the application of mirror therapy in stroke rehabilitation.

PMID: 15754176 [PubMed - indexed for MEDLINE]

Related articles

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- Further evidence for excitability changes in human primary motor cortex during ip [Neurosci Lett. 2008]
- Review Role of the ipsilateral motor cortex in voluntary movement. [Can J Neurol Sci. 1997]
- Review Neurophysiology of unimanual motor control and mirror movem [Clin Neurophysiol. 2008]

» See reviews... | » See all...

18: Cyberpsychol Behav. 2004 Jun;7(3):327-32.

Training with computer-supported motor imagery in post-stroke rehabilitation.

Gaggioli A, **Morganti F**, **Walker R**, **Meneghini A**, **Alcaniz M**, **Lozano JA**, **Montesa J**, **Gil JA**, **Riva G**.

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Converging lines of evidence suggest that motor imagery (the mental simulation of a motor act within working memory) is associated with subliminal activation of the motor system. This observation has led to the hypothesis that cortical activation during motor imagery may affect the acquisition of specific motor skills and help the recovery of motor function. In this paper, we describe a clinical protocol in which we use interactive tools to stimulate motor imagery in hemiplegic stroke patients, thereby helping them to recover lost motor function. The protocol consists of an inpatient and an outpatient phase, combining physical and mental practice. In the inpatient phase, patients are trained in a laboratory setting, using a custom-made interactive workbench (VR Mirror). After discharge, patients use a portable device to guide mental and physical practice in a home setting. The proposed strategy is based on the hypotheses that: (a) combined physical and mental practice can make a cost-effective contribution to the rehabilitation of stroke patients, (b) effective mental practice is not possible without some form of support, from a therapist (as in our inpatient phase) or from technology (as in the outpatient phase), (c)

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- A strategy for computer-assisted mental practice in stroke rehabilita [Neurorehabil Neural Repair. 2006]
- Review Mental imagery and its potential for physical therapy. [Phys Ther. 1988]
- Review Virtual reality in stroke rehabilitation: a systematic review of its [Top Stroke Rehabil. 2007]

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- Presence and rehabilitation: toward second-generation virtual reality [J Neuroeng Rehabil. 2004]

the inclusion of an outpatient phase will allow the patient to practice more often than would otherwise be possible, therefore increasing the speed and/or effectiveness of learning, and (d) the use of interactive technology will reduce the patient's need for skilled support, therefore improving the cost-effectiveness of training.

PMID: 15257833 [PubMed - indexed for MEDLINE]

19: Pain. 2004 Mar;108(1-2):192-8.

ELSEVIER FULL-TEXT ARTICLE

Graded motor imagery is effective for long-standing complex regional pain syndrome: a randomised controlled trial.

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Complex regional pain syndrome type 1 (CRPS1) involves cortical abnormalities similar to those observed in phantom pain and after stroke. In those groups, treatment is aimed at activation of cortical networks that subserve the affected limb, for example mirror therapy. However, mirror therapy is not effective for chronic CRPS1, possibly because movement of the limb evokes intolerable pain. It was hypothesised that preceding mirror therapy with activation of cortical networks without limb movement would reduce pain and swelling in patients with chronic CRPS1. Thirteen chronic CRPS1 patients were randomly allocated to a motor imagery program (MIP) or to ongoing management. The MIP consisted of two weeks each of a hand laterality recognition task, imagined hand movements and mirror therapy. After 12 weeks, the control group was crossed-over to MIP. There was a main effect of treatment group ($F(1, 11) = 57$, $P < 0.01$) and an effect size of approximately 25 points on the Neuropathic pain scale. The number needed to treat for a 50% reduction in NPS score was approximately 2. The effect of treatment was replicated in the crossed-over control subjects. The results uphold the hypothesis that a MIP initially not involving limb movement is effective for CRPS1 and support the involvement of cortical abnormalities in the development of this disorder. Although the mechanisms of effect of the MIP are not clear, possible explanations are sequential activation of cortical pre-motor and motor networks, or sustained and focussed attention on the affected limb, or both.

PMID: 15109523 [PubMed - indexed for MEDLINE]

Related articles

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- Review Stroke, complex regional pain syndrome and phantom limb pain: can [J Rehabil Med. 2007]
- Movement imagery increases pain in people with neuropathic pain following complete th [Pain. 2008]
- Review Chronic regional pain syndrome, type 1: Part II. [AORN J. 2000]

» See reviews... | » See all...

Cited by 2 PubMed Central articles

- Chronic non-specific low back pain - sub-groups or a single mechan [BMC Musculoskelet Disord. 2008]
- Review Neuropathic pain: a practical guide for the clinician. [CMAJ. 2006]

20: Arch Phys Med Rehabil. 2003 Jul;84(7):1090-2.

ELSEVIER FULL-TEXT ARTICLE

Using motor imagery in the rehabilitation of hemiparesis.

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OBJECTIVE: To examine the effectiveness of using motor imagery training in the rehabilitation of hemiparesis. DESIGN: A before-after trial with clinical and behavioral analyses of single cases. SETTING: Academic-affiliated rehabilitation hospital. PARTICIPANTS: Two survivors of embolic middle cerebral artery stroke that resulted in chronic hemiparesis. INTERVENTION: A motor imagery training program consisting of imagined wrist movements (extension, pronation-supination) and mental simulations of reaching and object manipulation making use of a mirror box apparatus. Twelve 1-hour experimental sessions were delivered, 3 times a week for 4 consecutive weeks.Main Outcome Measures: Two clinical assessments, grip strength, 4 wrist functionality measurements, and 3 timed performance tests. All outcome measures were recorded before training began, at 3 times during the intervention month, with 2 additional long-term measurements. RESULTS: Performance of the paretic limb improved after the imagery intervention, indicated by increases in assessment scores and functionality and decreases in movement times. The improvements over baseline performance remained stable over a 3-month period. CONCLUSIONS: These results demonstrate the potential for using motor imagery as a cognitive strategy for functional recovery from hemiparesis. The intervention targets the cognitive level of action processing while its effects may be realized in overt behavioral performance.

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- Review Efficacy of motor imagery in post-stroke rehabilitation: a system [J Neuroeng Rehabil. 2008]
- Review Motor imagery: a backdoor to the motor system after stroke? [Stroke. 2006]

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Cited by 2 PubMed Central articles

- Mental practice-based rehabilitation training to improve arm function and daily [BMC Neurol. 2008]
- Effects of mental practice embedded in daily therapy compared to therapy a [BMC Neurol. 2007]

21: Neurorehabil Neural Repair. 2000;14(1):73-6.

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Doing it with mirrors: a case study of a novel approach to neurorehabilitation.

Sathian K, **Greenspan AI**, **Wolf SL**.

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Arm amputees can experience the perception of movement of a phantom limb while looking at a mirror reflection of the moving, intact arm superimposed on the perceived phantom. Such use of a mirror to provide illusory visual feedback of movement can be useful in rehabilitation of hemiparetic patients. In this case report, we describe the successful application of "mirror therapy" to the post-stroke rehabilitation of a patient with poor functional use of an upper extremity, due mainly to somatosensory deficits. Mirror therapy facilitated employment of a motor copy strategy (bimanual movements) and later progression to "forced use" of the affected arm. The end result was increased functional use of the affected upper limb.

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Related articles

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- Remodeling the brain: plastic structural brain changes produced by different motor [Stroke. 2008]
- Mirror therapy promotes recovery from severe hemiparesis: a r [Neurorehabil Neural Repair. 2009]
- *Review* Upper limb movements and cerebral plasticity in post-stroke [Aging Clin Exp Res. 2008]
- *Review* Motor learning: its relevance to stroke recovery and neurorehabil [Curr Opin Neurol. 2006]

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- Reaching with alien limbs: visual exposure to prosthetic hands in a n [Percept Psychophys. 2006]
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- Visual bias of unseen hand position with a mirror: spatial and temporal factors. [Exp Brain Res. 2005]

» See all...

22: Lancet. 1999 Jun 12;353(9169):2035-6.

THE LANCET FULL-TEXT ARTICLE

Rehabilitation of hemiparesis after stroke with a mirror.

Altschuler EL, **Wisdom SB**, **Stone L**, **Foster C**, **Galasko D**, **Llewellyn DM**, **Ramachandran VS**.

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Related articles

- Physical therapy in the acute care hospital and nursing home: treatmen [QRB Qual Rev Bull. 1978]
- [Rehabilitation of hemiplegics] [Schweiz Arch Neurol Neurochir Psychiatr. 1969]
- [Rehabilitation of hemiplegics] [Schweiz Arch Neurol Neurochir Psychiatr. 1969]
- *Review* [Rehabilitation of stroke patients. Possibilities, duration and effect] [Nord Med. 1991]
- *Review* Rehabilitation of hemiplegia: indices of assessment and prognosis. [Br Med J. 1972]

» See reviews... | » See all...

Cited by 3 PubMed Central articles

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- Visual bias of unseen hand position with a mirror: spatial and temporal factors. [Exp Brain Res. 2005]
- When mirrors lie: "visual capture" of arm position impairs reachin [Cogn Affect Behav Neurosci. 2004]

23: Med Hypotheses. 1999 Apr;52(4):303-5.

ELSEVIER FULL-TEXT ARTICLE

Can mirrors alleviate visual hemineglect?

Ramachandran VS, **Altschuler EL**, **Stone L**, **Al-Aboudi M**, **Schwartz E**, **Siva N**.

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Following right hemisphere stroke, many patients display an indifference to objects and events in the left side of the world ('neglect'). Here, we describe a new technique that might help accelerate recovery from neglect. The patient sits at a table and a mirror is propped vertically on the patient's right side in the parasagittal plane, so that when the patient rotates his head rightward and looks into the mirror, he sees the neglected side of the world reflected in the mirror. Our question was: since the sensory information was now coming from the non-neglected left side, would this somehow make him overcome the neglect? In pilot experiments, two types of responses were seen: (a) In one subset of patients the presence of the mirror seemed to enhance the patients' awareness of the neglected field, so that they reached correctly for an object that was shown in the neglected field. Will repeated practice with this task accelerate recovery from neglect? (b) The second group of patients kept reaching into the mirror to grasp the reflection or kept groping behind the mirror ('mirror agnosia'). If the mirror was placed in

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- *Review* Neglect: mirror, mirror, on the wall--is the left side there at all? [Curr Biol. 1997]
- Multiple perceptual distortions and their modulation in leftsided visual neglect. [Neuropsychologia. 2000]
- *Review* [Neuropsychological approach to visual attention] [Brain Nerve. 2007]

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the coronal position and the object placed behind their head, then some of these patients (from group B) reached correctly for the object. Quite apart from its obvious theoretical implications, we believe this technique might provide a new approach for the treatment of visual hemineglect.

PMID: 10465667 [PubMed - indexed for MEDLINE]