American Pain Society
RESEARCH
EDUCATION
TREATMENT
ADVOCACY
PUBLISHED BY ELSEVIER

The Journal of Pain, Vol 17, No 2 (February), 2016: pp 167-180
Available online at www.jpain.org and www.sciencedirect.com

The Efficacy of Movement Representation Techniques for Treatment of Limb Pain—A Systematic Review and Meta-Analysis

Holm Thieme,[*,†] Nadine Morkisch,[‡,§] Christian Rietz,[¶] Christian Dohle,[‡,§] and Bernhard Borgetto[*]

[*]Faculty of Social Work and Health, University of Applied Sciences and Arts, Hildesheim, Germany.
[†]First European School for Physiotherapy, Occupational Therapy, and Speech and Language Therapy, Clinic Bavaria Kreischa, Kreischa, Germany.
[‡]MEDIAN Clinic Berlin-Kladow, Berlin, Germany.
[§]Center for Stroke Research Berlin, Charité – University Medicine Berlin, Berlin, Germany.
[¶]Department of Special Education and Rehabilitation, Faculty of Human Sciences, University of Cologne, Germany.

Abstract: **Relatively new evidence suggests that movement representation techniques (ie, therapies that use the observation and/or imagination of normal pain-free movements, such as mirror therapy, motor imagery, or movement and/or action observation) might be effective in reduction of some types of limb pain. To summarize the evidence regarding the efficacy of those techniques, a systematic review with meta-analysis was performed. We searched Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, CINAHL, AMED, PsychINFO, Physiotherapy Evidence Database, and OTseeker up to August 2014 and hand-searched further relevant resources for randomized controlled trials that studied the efficacy of movement representation techniques in reduction of limb pain. The outcomes of interest were pain, disability, and quality of life. Study selection and data extraction were performed by 2 reviewers independently. We included 15 trials on the effects of mirror therapy, (graded) motor imagery, and action observation in patients with complex regional pain syndrome, phantom limb pain, poststroke pain, and nonpathological (acute) pain. Overall, movement representation techniques were found to be effective in reduction of pain (standardized mean difference [SMD] = −.82, 95% confidence interval [CI], −1.32 to −.31, *P* = .001) and disability (SMD = .72, 95% CI, .22–1.22, *P* = .004) and showed a positive but nonsignificant effect on quality of life (SMD = 2.61, 85% CI, −3.32 to 8.54, *P* = .39). Especially mirror therapy and graded motor imagery should be considered for the treatment of patients with complex regional pain syndrome. Furthermore, the results indicate that motor imagery could be considered as a potential effective treatment in patients with acute pain after trauma and surgery. To date, there is no evidence for a pain reducing effect of movement representation techniques in patients with phantom limb pain and poststroke pain other than complex regional pain syndrome.**

Perspective: ***In this systematic review we synthesize the evidence for the efficacy of movement representation techniques (ie, motor imagery, mirror therapy, or action observation) for treatment of limb pain. Our findings suggest effective pain reduction in some types of limb pain. Further research should address specific questions on the optimal type and dose of therapy.***

Key words: *Movement representation techniques, motor imagery, action observation, mirror therapy, limb pain, complex regional pain syndrome, phantom limb pain, poststroke pain.*

Received June 11, 2015; Revised September 29, 2015; Accepted October 14, 2015.
Christian Dohle and Bernhard Borgetto share last authorship.
This study was financially supported by the Federal Ministry for Education and Research Germany (01KG1212) and the ZVK Foundation for the promotion of research in physiotherapy.
Christian Dohle is first author of 1 included study. He was not involved in data extraction and methodological rating of this study. Christian Rietz is coauthor of 1 included study. He was not involved in data extraction and methodological rating of this study.
All other authors have no conflicts of interest to declare.
Address reprint requests to Dr. Holm Thieme, PhD, Faculty of Social Work and Health, University of Applied Sciences and Arts, Goschentor 1, Hildesheim 31134, Germany. E-mail: holm.thieme@hawk-hhg.de

1526-5900/$36.00

http://dx.doi.org/10.1016/j.jpain.2015.10.015

There are several perspectives for classification of pain, such as the time since the beginning of a pain condition (ie, acute pain within 3 months and chronic pain for more than 3 months from pain onset) or regarding the function of pain. Although acute pain is often associated with actual or potential tissue damage that provides a protective function and so could be called "physiological," the absence of such a protective function can be seen as pathological. Pathological pain has been defined as "severe persistent pain or moderate pain of long duration that disrupts sleep and normal living, ceases to serve a protective function, and instead degrades health and functional capability…".[13] Chronic and pathological pain in their definitions seem to overlap widely. Pathological limb pain includes conditions such as phantom limb pain (PLP), complex regional pain syndrome (CRPS), or central pain.

Pain conditions are associated with reduced health-related quality of life (HRQOL) in different domains, such as physical functioning, emotional functioning, sleep, and role and social functioning.[23,28,37,54] Especially chronic pain represents one of the most prevalent, disabling, and expensive public health conditions, and affects more than 100 million people in the United States of America, with annual costs to society estimated at 635 billion US dollars.[24] Greater pain intensity was found to be associated with reduced HRQOL, physical functioning, wellbeing, and adverse effect on employment status or productivity.[26,27] Changes in pain intensity are correlated to changes in HRQOL.[37]

Current treatment options for acute and chronic pain conditions include orally or locally applied drugs, surgical interventions, and physical treatments.[2,18,19,21,31,46,47,57] Relatively new evidence suggests that movement representation techniques might be effective in reduction of limb pain, especially chronic limb pain conditions.[10,12,41,42,47,52,58] We defined movement representation techniques as any type of therapy that uses the representation of movement, especially observation and/or imagination of normal pain-free movements. These approaches can be combined with movement execution and with sensory stimulation to facilitate pain-free movements of the affected limb. Interventions include mirror therapy (MT), motor imagery (MI), and movement and/or action observation (AO). MT is defined as an intervention that uses a mirror to create a reflection of the nonaffected upper or lower limb, and thus provides the patient a visual feedback of normal pain-free movement of the affected limb.[51] MI is defined as a process during which an individual mentally simulates a movement or action without actual movement execution. This type of movement imagination implies that the subject feels herself or himself performing the movement.[15] AO refers to the visual perception of a given action by others. For observation the actual performance of another person or even video or virtual setups can be used. Movement representation techniques are inexpensive and very simply administered therapeutic options with no or only minimal adverse effects that can be applied by therapists and/or patients independently as well.

Chronic pain conditions, such as PLP or CRPS, are associated with reorganization of motor and sensory cortical networks in the way that the painful regions are often enlarged and shifted compared with the representation of healthy limbs.[22,34,36,44] Movement representation techniques were developed to directly target these cortical disruptions and restore the integrity of neural processing in the sensory motor cortex in patients with limb pain. Although functional brain imaging studies have supported the proposed cortical activation for these therapies especially in healthy adults, some evidence suggests the same mechanisms in patients with limb pain.[34,44,59]

MT was originally proposed by Ramachandran and coworkers for treatment of PLP.[52] Later, its effect in CRPS and other pain syndromes also have been shown.[7,38,55] Moseley proposed that MT was the most effective part within a "mental imagery program," consisting of 2 weeks of hand laterality judgement, mental imagery, and MT.[41,42] Ezendam et al[20] and Rothgangel et al[53] performed systematic reviews on the efficacy of MT and found that this therapy might effectively reduce pain in patients with CRPS and in patients with neuropathic limb pain (eg, in patients with PLP and chronic pain after surgery). However, these systematic reviews focused on MT as an experimental intervention and were limited because of restricted search strategies. Furthermore, no meta-analysis was performed. Results of a systematic review suggest that graded MI (GMI), a combination of lateral judgement training, MI, and MT, is effective in reduction of limb pain.[4] However, the results are on the basis of only a few studies and no systematic review exists regarding the effects of MI itself for treatment of limb pain conditions. AO was found to have positive effects on motor performance in stroke patients,[11] patients with Parkinson disease,[49] and orthopedic patients.[3] However, little is known regarding pain-decreasing effects.

Despite these promising findings, to our knowledge, to date no systematic review exists on the efficacy of different movement representation techniques for treatment of patients with acute as well as chronic limb pain conditions of any type. Therefore, the aim of this systematic review was to summarize the current evidence regarding the efficacy of movement representation techniques in reduction of limb pain and disability, and improvement of quality of life in patients with limb pain conditions.

Methods

The protocol of this study was published at PROSPERO (http://www.crd.york.ac.uk/PROSPERO/; registration number: CRD42014007152)

Search Strategy

Up to August 2014 we searched the following electronic databases: Cochrane Central Register of Controlled Trials, MEDLINE, CINAHL, EMBASE, AMED, PsychINFO, the Physiotherapy Evidence Database (PEDro), and OTseeker.