The effects of graded motor imagery and its components on chronic pain: a systematic review and meta-analysis

K. Jane Bowering, Neil E. O'Connell, Abby Tabor, Mark J. Catley, Hayley B. Leake, G. Lorimer Moseley, Tasha. R Stanton

Graded motor imagery (GMI) is a recently developed technique which targets the cortical reorganisation occurring in chronic pain conditions such as phantom limb pain and complex regional pain syndrome. GMI is a three-stage treatment that gradually engages cortical motor networks without triggering the protective response, pain. The three constituent stages of GMI are left/right judgements, motor imagery, and mirror therapy. These three stages aim to incrementally activate different motor cortical areas, activating previously established neural connections within the brain, and, in doing so, aid in the gradual reversal of cortical reorganisation. While GMI and its constituent components are recommended in clinical guidelines, it is still unknown whether the effects of GMI are greater than the effects of its constituent parts.

OBJECTIVE

To synthesise all evidence concerning the effects of graded motor imagery and its constituent components on chronic pain.

PROTOCOL

An electronic search was performed using the following databases: Medline (via OvidSP), Embase (via Ovid SP), CINAHL, Scopus, Academic Search Premier, Web of Science, Allied and Complementary Medicine, PubMed, the Cochrane Collaboration and the Physiotherapy Evidence Database (PEDro). A sensitive search was completed using a combination of keywords and relevant subjects heading for GMI, its components, and chronic pain. Searches were limited to English language and humans only. Studies were retained if they met the following criteria: human adult subjects (>18 years of age); clinically validated pain measure used; randomised controlled trial; subjects all had a chronic pain condition lasting longer than 3 months. Pain intensity ratings were the primary outcome of interest for this review.

RISK OF BIAS

Two reviewers independently assessed the risk of bias of included studies using an adapted combination of The Cochrane Collaboration's tool for assessing risk of bias and the PEDro Scale. The majority of studies had a high risk of bias.

RESULTS

The initial search yielded 6160 studies, of which 6 RCT's were included.

Study	Condition	Intervention	Comparison	Effect Size
1	Chronic pain following stroke	Mirror therapy	Bilateral hand movements	0.03 (-0.62, 0.69)
2	CRPS1	Mirror therapy	Covered mirror therapy	N/A
		Motor imagery	Mirror therapy	N/A
3	PLP	Mirror therapy	Covered mirror therapy	0.73 (-0.46, 1.92)
		Mirror therapy	Motor imagery	1.85 (0.40, 3.29)^
		Motor imagery	Mirror therapy	-1.05 (-2.30, 0.19)
4	CRPS1, PLP following amputation or brachial plexus avulsion	Left/right judgements	Usual care	0.44 (-0.12, 1.00)
		GMI	Usual care	0.89 (0.31 to 1.47)^
5	CRPS1	GMI	MI, left/right, MI	0.73 (-0.41, 1.87)
		GMI	Left/right, mirror, left/right	0.99 (-0.19 to 2.17)
6	CRPS1	Left/right judgements	Usual care	0.29 (-0.81, 1.39)
		GMI	Usual care	1.70 (0.36, 3.04)^

GMI Programme: Two studies comparing GMI to usual physiotherapy care both found large effect sizes (1.70 (0.36, 3.04)[6] and 0.89 (0.31, 1.47) [4]). One study which compared a course of GMI to an unordered course of GMI, moderate to large effects in favour of the ordered GMI were found (0.73 (CI: -0.41, 1.87) [5] and 0.99 (CI: -0.19, 2.17) [5]). The immediate post-intervention results of two studies[4,6] were pooled producing a large pooled effect size (1.06 (0.41, 1.71)). Follow-up data at 12 weeks and 6 months mirrored initial findings.

Left/Right judgments: No studies evaluated left/right judgments as the primary intervention. Two studies investigated the effects of left/right judgments as part of a GMI programme on chronic pain. Neither study found statistically significant effect estimates for left/right judgements reducing pain as compared to usual care (0.29 (CI: -0.81, 1.39) [6] and 0.44 (CI:-0.12, 1.00) [4]). Pooled data produced small, non-significant effect estimate (0.41 (CI: -0.09, 0.91).

Motor Imagery: None of the studies had a primary aim of evaluating the effects of motor imagery on chronic pain. In two studies, motor imagery was used as a secondary control group and was compared to covered mirror therapy, producing contrasting results. One study found mirror therapy to be much more effective at reducing pain as compared to motor imagery, with a large negative effect found (-1.05 (-2.30, 0.19) [3]). Interestingly, participants receiving motor imagery treatment had increased pain levels (as compared to baseline pain). Similarly in the second study six out of eight participants experienced increased pain levels following four weeks of motor imagery[2].

Mirror Therapy: Three studies found positive effects of mirror therapy in reducing pain. The effect sizes ranged from trivial (0.03 (CI: -0.62, 0.69) [1], to moderate (0.73 (CI: -0.46, 1.92) [3], to large (1.85 (CI: 0.40, 3.29)). However, this final effect size was the only statistically significant finding in the motor imagery analyses.

The effectiveness of GMI and its components is encouraging, but not certain. While mirror therapy as a sole treatment decreases pain, the effects of the first two stages, left/right judgements and motor imagery, are unclear. The combination of all three in a six-week programme of GMI appears to be the most efficacious.

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