Literature Review

While much of the literature on graded motor imagery exposure supports it as an intervention for treatment of chronic regional pain syndrome and phantom pain following amputation, evidence on motor imagery as a method to facilitate motor learning and control as well as neuroplasticity supports its use an intervention for chronic low back pain. Chronic pain has been found to lead to changes in the brain including decreased gray matter density in the right thalamus and bilateral dorsolateral prefrontal cortex.1 This reduction in gray matter is equivalent to the amount of gray matter loss following 10-20 years of aging.1 Chronic pain can lead to the cortical remapping so that areas of the brain that anticipate, modulate, experience, and suppress pain are no longer appropriately functioning and the degree of change has been shown to correlate with the length of time of the pain.1 In a study that compared brain activity in the left supplementary motor area and right superior temporal sulcus for chronic low back pain patients when they completed a motor imagery activity, researchers found that chronic low back pain patients showed significantly decreased activity in those regions compared to healthy controls. They also found that there was greater functional connectivity between these regions for chronic low back pain patients indicating that chronic pain leads to reorganization in the sensorimotor network.2 Motor imagery has been found to target the same areas of the brain that are responsible for motor movement and combining motor imagery with physical movement has been shown to enhance performance more than physical movement alone.3 For chronic low back pain patients with fear avoidance, graded motor imagery can be a starting point for patients who fear movement by having them imagine pain free back movement to help reactivate areas in the brain that have not been activated due to their fear of movement.4 Graded motor imagery targets cortical disorganization and activates areas that have become less active due to chronic pain and gives patients the opportunity to grade their exposure to the motor movements they currently fear.5

Bibliography

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Evidence Table

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| Title/author/year  | Purpose | Design and Subjects | Intervention | Outcome Measures | Results | Strengths and Limitations |
| The Effects of Graded Motor Imagery and Its Components on Chronic Pain: A Systematic Review and Meta-analysis by Bowering et al 2013 | To find how effective graded motor imagery was in treating chronic pain.  | Systematic review;6 RCTS that included a graded motor imagery program or at least one component of a full graded motor imagery program. Patient in the studies had complex regional pain syndrome.  | 6 RCTs that included at least one of the stages of graded motor imagery (GMI) and a meta-analysis was conducted that analyzed the effectiveness of GMI vs standard physical therapy. GMI programs in the RCTs lasted 4 to 6 week each. | McGill Pain Questionnaire, visual analog scale, numeric rating scale, and neuropathic pain scale | GMI was found to have moderate effect size compared to unordered GMI (typical order is 1) left/right discrimination 2) explicit motor imagery 3) mirror therapy) and a large effect size when compared to standard physical therapy care.  | Strengths: meta-analysis that could include a larger sample, since many of the sample sizes for the studies were lowLimitations: significant heterogeneity between study populations, very few studies had follow up, range of methods was used between studies  |
| The impact of cortical remapping interventions on pain and disability in chronic low back pain: a systematic review by Daffada et al 2014 | To find the effective of cortical remapping through graded motor imagery and mirror visual feedback  | Systematic review that included 5 studies ( 3 RCTs, 1 randomized cross-over study, and 1 multiple case design). Sample sizes ranged from n=3 to n=75 | All studies included either graded motor imagery or mirror visual feedback, although some studies used additional components of sensorimotor retraining including motor control exercise and sensory discrimination retraining | Oswestry Disability Index, McGill Pain Questionnaire, Roland Morris Disability Questionnaire and Visual Analog Scale | Key findings include: visualization of lumbar spine through mirror visual feedback significantly decreased pain levels and duration of low back pain, specific motor retraining lead to a corrective medial shift in transversus abdominus primary motor cortex to a locus more similar to healthy participants | Strengths: no conflict of interests or affiliations with well-known PNE figuresLimitations: heterogeneity between studies, smaller sample sizes in studies, no long term follow up |
| Movement-related Back Pain is Reduced by Visualization of the Back during Movement by Wand et al 2012 | To find if mirror visual feedback is an effective intervention for chronic low back pain patients  | Randomized cross experiment; n= 25 participants with chronic nonspecific low back pain (>6 months) | Mirror visual feedback during repeated lumbar movements  | Visual analog scale and “Time to Ease” (how long it took back pain to return to baseline following repeated movement) | Average post-movement pain intensity decreased with visual feedback from mirror compared to no visual feedback. There was also decreased time to ease for patients when they had visual feedback. | Limitations: participants were not blinded to condition due to experiment design and small sample size |
| Graded motor imagery modifies movement pain, cortical excitability, and sensorimotor function in complex regional pain syndrome by Strauss et al 2021 | To find how effective graded motor imagery is for modifying movement pain in patients with chronic complex regional pain syndrome | Longitudinal wait list control design; n=21 participants with chronic complex regional pain syndrome | 6-week graded motor imagery program | DASH and somatosensory cortex functional MRI activation | Use of graded motor imagery, decreased pathological characteristics of CRPS such as the typical increased primary somatosensory cortex activation  | Limitations: small sample size, especially given design type |
| Using Graded Motor Imagery in the Management of Chronic Low Back Pain by Iglar et al | To outline how graded motor imagery can affect the physical therapy outcomes of a patient with chronic low back pain | Case Report; n=1 (33 year old male with chronic low back pain lasting 10 years) | 4 physical therapy sessions that included implementation of 3 stages of graded motor imagery and use of graded exposure to therapeutic exercise | Oswestry Disability Index, Fear-Avoidance Beliefs Questionnaire, and Numeric Pain Rating Scale | Following treatment sessions, ODI score improved by 10% and FABQ and pain rating scale scores showed a clinically significant difference | Limitations: case report |

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