Systematic review

The impact of cortical remapping interventions on pain and disability in chronic low back pain: A systematic review

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Abstract

Background Cortical change, in the manner of cortical remapping is a common feature of and potential driver for chronic low back pain (CLBP). Novel interventions such as graded motor imagery (GMI) and mirror visual feedback (MVF) have been shown to facilitate correction of cortical changes and improve symptoms in other chronic pain states. However, little is known regarding the effectiveness of these treatment approaches in CLBP.

Objective To identify and assess the current evidence regarding the effectiveness of interventions which target cortical remapping in the management of CLBP.

Data sources The electronic databases Medline, Embase, CINAHL, AMED, OVID, PEDro, BNI, PsycINFO, HMIC, and Cochrane library were systematically searched.

Study selection Of 11 potential citations identified, 5 articles were identified for inclusion and critiqued. These comprised 3 randomised controlled trials (RCTs), 1 randomised cross-over study, and 1 multiple case study design.

Results Visualisation of lumbar movement may significantly improve movement-related pain severity and duration. A combined sensorimotor retraining approach has been shown to produce short-term improvements in both pain and disability outcomes in CLBP. The relative effectiveness of individual interventions and their long-term efficacy have yet to be established.

Conclusions There is a paucity of robust literature which has examined the application and efficacy of these novel treatments in the management of CLBP. Results from the few CLBP studies which are available are encouraging. Further, robust research is needed to optimise treatment protocols and establish their long-term effectiveness in CLBP.

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Keywords: Chronic low back pain; Cortical remapping; Graded motor imagery; Sensory discrimination; Mirror visual feedback

Introduction

Low back pain (LBP) constitutes a major public health problem in Westernised societies. Recent research has shown that the total healthcare costs of CLBP patients is approximately double those of matched controls [1], and that CLBP is the single greatest cause of global disability [2]. Whilst estimates may vary considerably, there is no doubt that

the financial impact of low back pain is significant and growing [3]. The clinical course of LBP is highly variable, with 3 to 10% of patients known to develop chronicity [4], defined as LBP which persists for 3 months or more [5]. Many CLBP management strategies have been proposed and trialled (including pharmacological, interventional, and surgical approaches), but have at best achieved moderate success [6]. It can be argued that to date healthcare strategies have focused too extensively on 'structural correction' [7], and that traditional manual therapies have, until relatively recently, been too impairment-orientated [4,7].

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Cortical remapping (CR), defined as neuronal reorganisation within the higher centres of the brain, secondary to cortical neuroplasticity, is a common feature of many chronic pain states [8] and has more recently been documented in CLBP [7]. Extensive CR has been identified in areas known to be involved in pain processing ('the pain neuromatrix') [9], somatosensation [10] and motor planning [11]. Brain imaging studies in CLBP patients have demonstrated significant changes in neurochemical profile [12], neuroanatomy [13,14], cortical representation [10], and cortical responsiveness [15], with the magnitude of change seen to be proportional to symptom chronicity and the level of associated depression or anxiety [12,15]. Whether these changes are cause or effect in CLBP has yet to be established, however, there is growing opinion that maladaptive neuroplastic changes within the central nervous system may play an important role in symptom generation and perpetuation in CLBP [7].

Several treatments have evolved which specifically target normalisation of cortical remapping. These include mirror-box or mirror visual feedback (MVF) therapies [16], graded motor imagery (GMI) [17], and sensory discrimination retraining (SDR) [18]. MVF and GMI both involve progression through a graded motor recruitment programme, whilst visual feedback of the unaffected, contralateral limb or body part is provided using mirrors [16]. Participants begin with basic motor imagery, such as recognition of limb laterality and imagined movements, and progress to more complex motor functions as symptoms allow. SDR targets an improvement in sensory acuity using various techniques such as two-point discrimination (TPD) or/and character recognition (Graphesthesia) [19]. All have been applied in the management of other chronic pain states including complex regional pain syndrome (CRPS) and phantom limb pain (PLP) with varying degrees of success [19–21].

Since there is growing evidence regarding the importance of cortical remapping in CLBP [7,8,10], it is reasonable to consider these treatment approaches in the management of this condition. However, the strength of evidence regarding their effectiveness in this patient population is unclear at this time. Two single case studies [22,23] have reported encouraging results using cortical remapping techniques and emphasise the need for further, high quality research in this area. The aim of this systematic review was to assess the current evidence regarding the effectiveness of treatment modalities which specifically target cortical reorganisation in the management of CLBP.

Methods

Data sources and search

A comprehensive online search was performed using Medline/Pubmed, OVID, EMBASE, Allied and Complementary Medicine (AMED), Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsychInfo, Physiotherapy Evidence Database (PEDro), British Nursing Index (BNI), Cochrane Library, and Healthcare Management Information Consortium (HMIC). The OVID platform was used to search AMED, EMBASE, HMIC, Medline, and PsycInfo, EBSCO for CINAHL, and ProQuest for BNI. Search strategies were developed using a standardised Population/Intervention/Comparison/Outcome (PICO) format [24]. Electronic searches were performed using both single, key search criteria, and combination searches using Boolean operators, from the inception date of each database to September 2013. Preliminary research had suggested that the number of articles matching key search parameters was likely to be small, so all multiple participant study designs were included, and no language restrictions were used. Key search terms are summarised in Fig. 1.

Eligibility criteria

The following inclusion/exclusion criteria were applied to retrieved records:

(1) *Subject population*: Chronic low back pain.
(2) *Interventions*: Graded motor imagery, mirror visual feedback therapy, sensory discrimination retraining and/or tone pitch recognition, including their derivatives and combination protocols.
(3) Interventions compared with relevant 'current practice' intervention (controlled trials only).
(4) *Primary outcome measures*: Pain, disability and relevant cortical imaging measures.
(5) Studies written in English (or English translation available).
(6) Animal model studies and unpublished studies *were not* considered.

Full text copies of the remaining eligible articles were obtained, and the same screening repeated to optimise relevance. Snowballing from the bibliographies of the final articles selected for inclusion in this paper was then applied.

Data extraction and analysis

Data extraction was independently performed by two reviewers (PD and SP) using a standardised data extraction proforma. Any differences of opinion were resolved by consensus. Attempts were made to contact the primary author of any studies where data supplied in the original publication was deemed to be incomplete or insufficient. A qualitative synthesis of methodological quality of each article was performed by the principal reviewer (PD) using the appropriate Critical Appraisal Skills Programme (CASP) criteria [25]. This was reviewed and corroborated by a second, independent reviewer (SP). A comprehensive analysis of risk of bias and study limitations is included in the results section of this paper.