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To Study The Added Effect Of Sensor motor Retraining In The Management Of Chronic Mechanical Low Back Pain – A Pilot Study Of 5 Participants.

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Abstract: Background: *The purpose of the study was to find out the added effect of sensorimotor retraining program alongwith conventional exercises in chronic mechanical low back pain patients. Pain and disability are the main symptoms of mechanical low back pain. There is a growing evidence of extensive cortical and neurochemical alterations in the brains of people with chronic mechanical low back pain (CMLBP), as these changes could contribute to the persistence of pain, targeting the brain can be a legitimate therapy.*

Materials & Methods :*An experimental study was carried out on 5 CMLBP patients through purposive random sampling in Talegaon Dabhade, Pune, India. Participants were given Sensorimotor Training alongwith conventional exercises for 10 weeks, each week day. Pre and post outcome measures were taken before and after the treatnment, NRS for Pain Intensity, ODI for pain interference with daily activities and RMDQ for self-reported disability.*

Results :*There was reduction in pain intensity, pain interference with daily activities and self- reported disability in the experimental group.*

Conclusions :*Positive results were reported in patients of CMLBP, hence sensorimotor retraining can be given in CMLBP as it shows similar effects in patients of phantom limb pain (PLP) and complex regional pain syndrome (CRPS).*

Keywords : *Chronic mechanical low back pain, cortical and neurochemical changes, sensorimotor training.*

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I. Introduction

Chronic low back pain is defined as pain lasting for more than 3 months. Furthermore, Chronic Mechanical low back pain (CMLBP) is defined as pain, muscle tension, or stiffness in low back that is below the coastal margin and above the inferior gluteal folds, without leg pain. The most important symptoms of mechanical low back pain are pain and disability.[1] The lifetime prevalence of low back pain is reported to be as high as 84%, and the prevalence of chronic low back pain is about 23%.[2] The incidence of mechanical LBP is higher in workers subjected to heavy physical exertion, such as weight lifting, repetitive movements, and frequent static postures.[1] The primary focus of many therapies on the structural or functional impairments in the spine maybe a contributing factor to the lack of success of current treatments. There is growing evidence of extensive cortical reorganization as well as neurochemical and structural alterations in the brains of people with CMLBP. These changes could contribute to the persistence of the problem and might represent an accurate target for therapy. [3] Certain neuroimaging studies have revealed numerous structural and functional changes within anatomy of brains of people with chronic musculoskeletal pain like neurochemical changes wherein some markers increase, while others decrease in the dorsolateral prefrontal cortex (DLPFC), thalamus and orbitofrontal cortex have been observed in people with CMLBP.[3] In a study wherein voxel- based morphometry, a statistical method of comparing grey matter and white matter in specific brain areas, have provided fairly compelling evidence of reduced grey matter in the DLPFC, the right anterior thalamus, the brainstem, the somatosensory cortex and the posterior parietal cortex of people with CLBP.[3] Also, treatments that directly target the restoration of cortical function have been shown to be effective in patients of PLP and CRPS. Furthermore, people with CMLBP have perceptual disturbances like those observed in PLP and CRPS. These disturbances are decreased tactile acuity, altered body perception and disruption of the working body schema. **SENSORIMOTOR TRAINING (SMT)** is a graded training program including two components, sensory training and motor training. [5] [6] SMT is a treatment approach that targets brain function. In other chronic pain conditions, such as CRPS and PLP sensorimotor training has proved to be effective; therefore, a similar approach can be useful in patients of CMLBP. [3] [5]

II. Material and Methods

This experimental study was carried out onpatients of Dr. Bhausaheb Sardesai Rural Hospital, Talegaon Dabhade, Pune, Maharashtra, India. A total of 5 adult subjects (both male and females) of age group 20 to 40 years were selected in this study.

Study Design: Experimental

Study Location: Patients coming to physiotherapy OPD at Dr. Bhausabheb Sardesai Rural Hospital, Talegaon Dabhade, Pune, Maharashtra, India.

Sample size: 5 patients

Subjects & selection method: The study population was drawn from patients visiting the OPD having chronic i.e more than 3 months of mechanical low back pain. Total 6 participants were selected for the program after evaluating the patients out of which 5 participated and the 6th one left the study in mid-week of the 10-week program.

Inclusion criteria:
1. Chronic pain i.e. more than 3 months
2. Age group 20 to 30 and 30 to 40
3. Score more than 4 on the Roland- Morris Disability Questionnaire (RMDQ)
4. Both male and female

Exclusion criteria:
1. Prolapsed intervertebral disc
2. Spinal pathology
3. Spondylolisthesis
4. Ankylosing spondylosis
5. Pregnant woman or less than 6 months postpartum
6. Patient who have undergone surgical operation of spine within 6 months.

Participants

10 participants were recruited out of which 2 did not fit into the age range, 1 did not meet the minimum score of RMDQ, 1 had acute pain. 6 were selected for the further treatment, out of which 1 left the treatment protocol mid-week. The selected participants fulfilled all the treatment criteria and provided written inform consent.

Participant 1. The first participant was 35-year-old man who had 1 child and worked full time in an IT company for almost 7 to 8 hours/day. He had a 4-year history of low back pain. The onset of pain was sudden. During those 4 years, he took no physiotherapy and always used ointment in case of severe pain. No red flags were present, there were no contraindications to exercise.

Participant 2. The second participant was 20-year-old woman who was a college student. She had a history of pain in the past 2 years, predominantly over the right side of her low back. The pain started during her final exams because of prolonged sitting habits without a proper back support. Pain used to be so severe initially, that lying down alone would relieve her pain. She also took physiotherapy for the same but had relief for time being. There was no contraindication to exercise and neural integrity appeared to be normal on screening.

Participant 3. The third participant was 28-year-old woman who worked at a pharmaceutical shop and had a long-standing job of continuous 6 hours with 1-hour break in between. She had a history of pain in the past 3 years. The onset of pain was sudden and aggravated after continuous standing. Sitting down was relieving. She was on pain relieving medications (NSAID) but had no relief even after taking medications. Her low back pain was more in the center. She had no contraindications for exercise.

Participant 4. The fourth participant was again a student studying in last year of B.COM. She was 21-year-old. Her pain history is 1-year old. Due to long hours of studies she started experiencing a sudden pain in her low back area. She also used a lumbar belt while studying but had relief only for time being. No red flag present, there are no contraindications to exercises as well.

Participant 5. The final participant was a 25-year-old woman who was married and had 1 child. Her history of pain is 4-year-old. Pain started after her pregnancy. She underwent a C-section during delivery. Since the she has on and off complaints of pain. Pain is more in the right side of low back. Initially she had taken physiotherapy but has no pain relief. Therefore, she revisited the clinic. No contraindications to exercise and neural integrity appeared normal.

Procedure methodology

After written informed consent was obtained, a well-designed questionnaire was used to collect the data of **pain intensity using numerical rating scale**(NRS), **pain interference with daily activities using Oswestry Disability Questionnaire** (ODI) **and self-reported disability using Roland Morris Disability Questionnaire**(RMDQ)**.**After collecting the questionnaire and required data, each patient was explained about the treatment and the effects of chronic pain on the structural and functional anatomy of brain of people having chronic mechanical low back pain. The treatment protocol i.e. Sensorimotor Training was explained in brief. Sensorimotor training is a graded training program that included 5 stages both in sensory as well as motor session. Each stage was of 2 weeks; hence, the total treatment was of 10 weeks. The average time of each treatment session was about 30 mins. Each patient was given conventional treatment with added Sensorimotor Training.

The conventional treatment included the following:hot pack for 10 mins, 2-channel TENS for 10 mins, static abdominals [16] (10 repetitions- 10 sec hold), static back extensors [16] (10 repetitions- 10 sec hold), pelvic bridging [19] (10 repetitions), cat-camel [20] (10 repetitions-10 sec hold), abdominal and back strengthening [16] (10 repetitions- graded progression).

Supervised sensorimotor training protocol: Sensory Retraining[4] [5] [11] [12]

Benedict et al designed a graded sensory discrimination retraining program based on the model used by Moseley et al for management of complex regional pain syndrome affecting the upper limb. Certain modifications were made to this protocol. The first stage included only localization training. Participants were shown a picture of back on which 12 random numbered dots were marked. Then, the therapist pressed lightly on a point with the blunt end of a pen on back of the participant. Participant had to refer the picture and guess the point stimulated. If the participants went wrong, they were told which point had been stimulated, and then the actual position of the point was stimulated. 3 blocks of 60 stimuli were given during the treatment session. In the second stage, participants were asked to determine both the localization and type of stimulus. Similar treatment was given as in the 1st stage, but this time both sharp (pen nib) and blunt end of the pen was used for stimulation. Participants had to guess the site as well as type of stimulation (whether sharp or blunt). Progression was done by increasing to 16 points. Third stage, included graphesthesia training. In this stage uppercase letters were drawn on the back and participants were asked to identify the letter drawn, if they guessed incorrectly, they were told the letter that was actually drawn. Progression was done by reducing the size and increasing the speed of drawing. Fourth and fifth stage included drawing three letter words and calculating simple sums respectively. Both the stages had same dosage and progression as that of the first two stages.

Motor Retraining:[3] [14] based on the graded motor imagery program (GMIP) that was previously used for complex regional pain syndrome. The initial stage involved laterality recognition. Using a recognize software participants were asked to determine the right/left side of the back. Progression was done by increasing the time per image was shown. The second stage like that of GMIP, involved imagined movements. In the 1st week a video that focused only on small- range lumbar movements were shown to the participants. These movements included anterior and posterior pelvic tilts, lateral glides, and bilateral arm elevation and bilateral hip flexion with the back still. In the 2nd week, the video showed full- range lumbar movements including forward flexion, extension, side- flexion and rotation. The third stage, involved isometric contraction of the lumbar spine muscles. This stage was different from the original GMIP. It included contraction of transversus abdominis and multifidus muscles. It is believed that activation of these muscles would serve as an ideal bridge between imagined and actual lumbar movements. During the first week, the participants performed isometric local muscle contraction then in the second week, progression involved maintenance of the local muscle co-contraction with limb loading. The next 2-week stage involved the performance of small-range lumbar spine movements with feedback maximized. Participants received instruction on pelvic tilting, lumbar spine side gliding, and pelvic rotation as well as several mechanisms for obtaining feedback about the movement performed, with an emphasis on visual feedback. These mechanisms involved moving while watching a reflection of the lumbar spine, moving while palpating the lumbar spine and moving while wearing elastic tape applied to the back. All movements needed to be pain-free. The final stage involved the same protocol but included full-range lumbar spine movements.

Following protocol was used: -

Stage	Sensory retraining	Motor retraining
1.	Localisation training • Determine site of stimulus without visual feedback.	Laterality recognition (using recognize software) • Determine left or right side of back. • Progress by time for which image was presented.
2.	Localisation and stimulus type • Determine site as well as type of stimulus without visual feedback. • Progress by adding points	Imagined movements • Using video of model performing small range movements in 1st week. • Full range in 2nd week.
3.	Graphesthesia training • Recognize letters • Progress by size and speed of drawing	Isometric local muscle recruitment • Transversus abdominis muscle[14] • Lumbar multifidus muscle[14] • Co- contraction with pelvic floor[14] • Dissociation exercises[14]
4.	Graphesthesia training • Recognize 3- letter words • Progress by size and speed of drawing.	Small-range movements with visual feedback • Visual feedback with mirror. • Intersegmental palpation performed by participant. • Tactile feedback from Kinesio tape.
5.	Graphesthesia training • Calculate simple sums • Progress by size and speed of drawing.	Full-range movements with visual feedback. • Visual feedback with mirrors. • Intersegmental palpation performed by participant. • Tactile feedback from Kinesio tape.

Statistical analysis

Data was analyzed using SPSS version 20 (SPSS Inc., Chicago, IL). Descriptive statistics including p-value, standard deviation and mean were calculated. Comparison of NRS, ODI and RMDQ within the groups was assessed using **Wilcoxonmatched pairs test** and comparison of NRS, ODI and RMDQ of two groups was assessed using **Mann-Whitney test.**

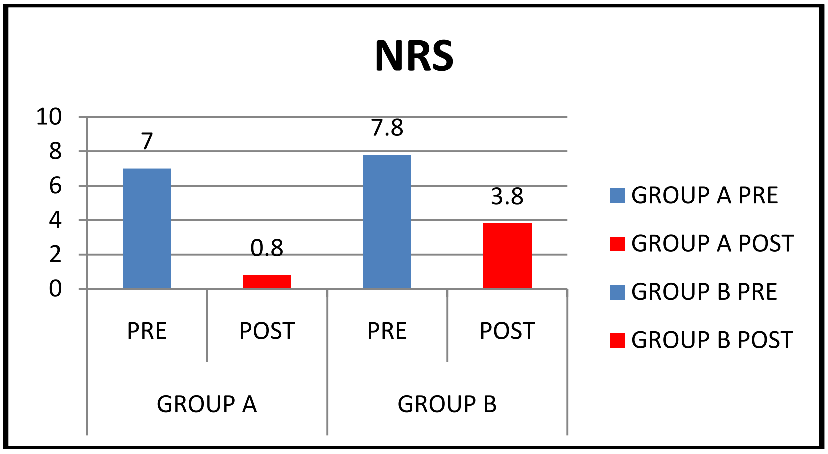
III. Result

After 10 weeks of treatment, following result was obtained. The result obtained was significant clinically as well as statistically. The p values were less than 0.01, considered to be significant.

The following table 1,2,3 and 4 represents data with respect to NRS, ODI and RMDQ of the control and experimental groups. Descriptive statistics including p- value, standard deviation and mean were calculated.

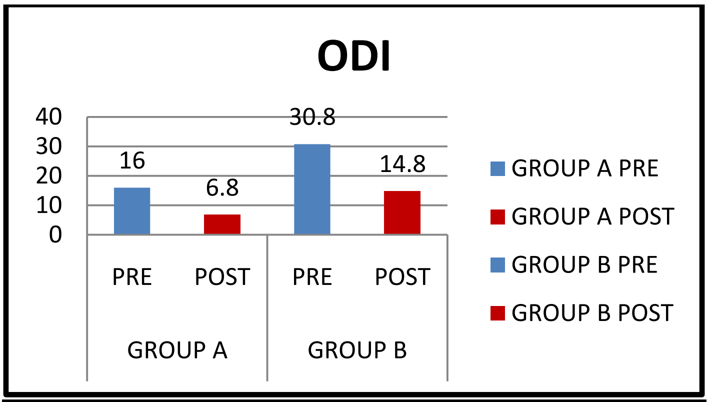
1.

NRS	p- value	significance	SD		Mean	
			pre	post	pre	post
Experimental	0.0313	Significant	1.414	1.095	7	0.8
Control	0.0313	significant	1.789	2.168	7.8	3.8



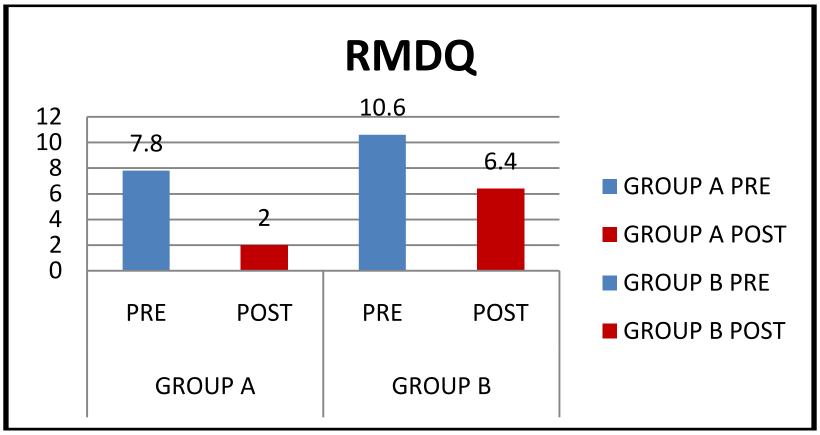
2.

ODI	p- value	significance	SD		Mean	
			pre	Post	pre	post
Experimental	0.0313	Significant	8.68	9	16	6.8
Control	0.0313	Significant	17.803	6.760	30.8	14.8



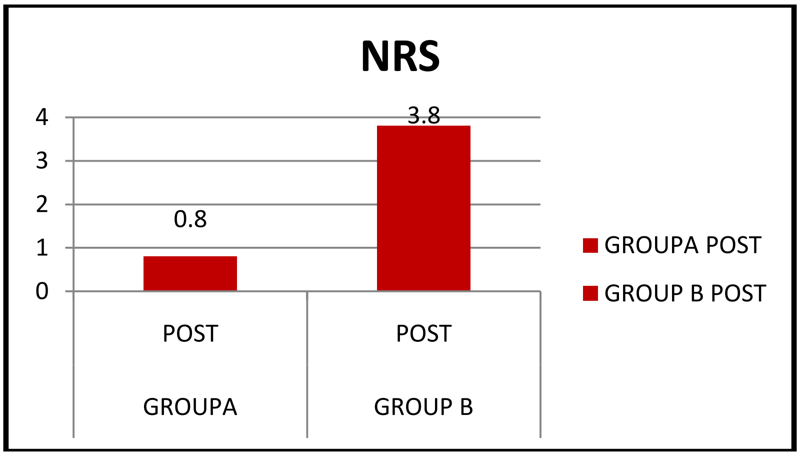
3.

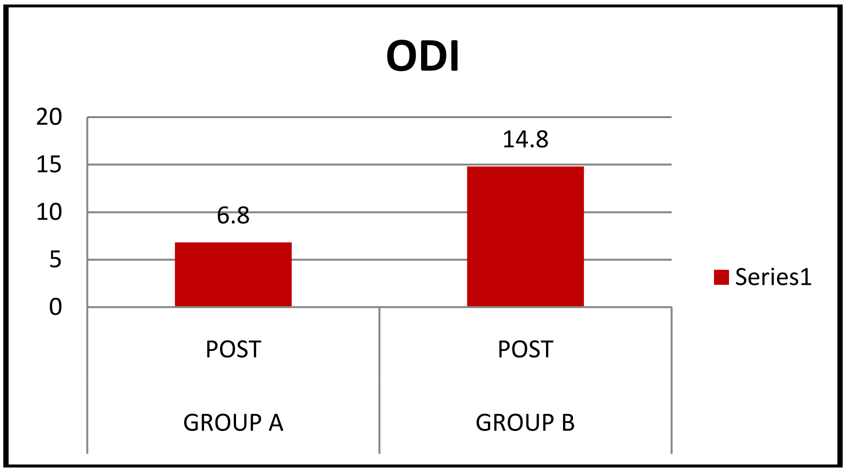
RMDQ	p- value	Significance	SD		Mean	
			pre	post	pre	post
Experimental	0.0313	Significant	3.033	1.414	7.8	2
Control	0.0625	Not quite significant	5.550	3.194	10.6	6.4

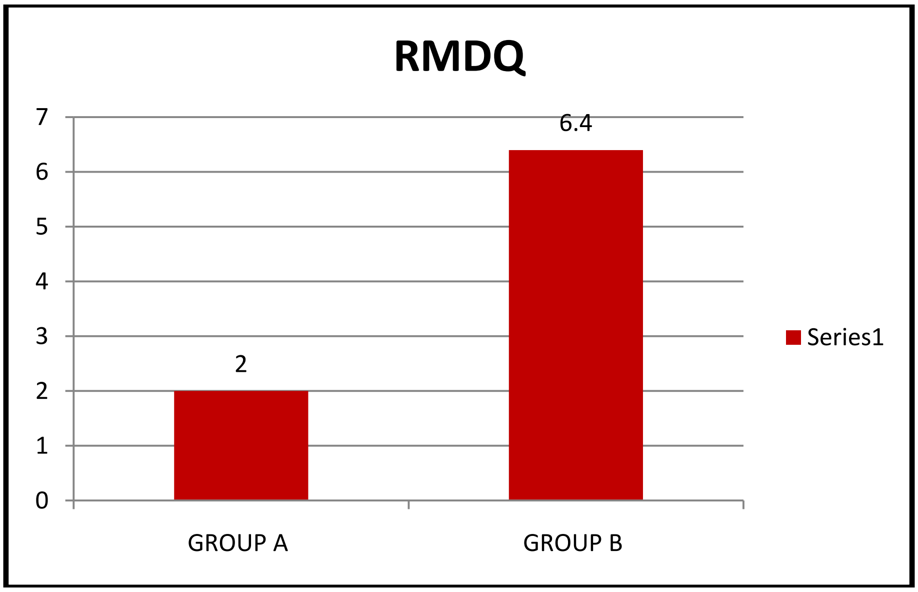


4.

Outcome measures	**p- value**	**significance**	**SD**		**Mean**	
			experimental	**control**	**experimental**	**control**
NRS	0.0373	Significant	1.095	2.168	0.8	3.8
ODI	0.0106	Significant	1.905	6.046	6.8	14.8
RMDQ	0.0079	Very significant	1.414	3.194	2	6.4







All participants showed reductions in pain intensity, pain interference and disability. The data further suggested that participants' clinical status improved with the treatment.

IV. Discussion

The purpose of this study was to investigate the effectiveness of sensorimotor training in decreasing CMLBP, for which 5 patients with CMLBP were taken Each patient received treatment every day for 10 weeks. In this study, NRS, ODI and RMDQ were a tool to evaluate the effect of treatment on patients with CMLBP. It was hypothesized that added effect of sensorimotor training would give better results than just conventional treatment. Also, the main result supported the hypothesis that gain was higher in the experimental group than the control group. The study revealed that both treatment groups obtained successful outcomes, but the comparison of NRS, ODI and RMDQ of both the groups showed significant difference and these changes were large enough to be considered clinically meaningful. Also, patients in the experimental group appeared to be more satisfied with the overall outcome of their rehabilitative treatment than patients in the control group.

Benedict et al in the 3rd international conference on movement of dysfunction 2009, suggested that, structural changes within the back might not be important, and there is growing evidence of extensive cortical reorganization as well as neurochemical and structural alterations in brains of people with CMLBP.[3] Also, due to incomplete understanding of cortical function it is possible to make a number of predictions to describe how the brain changes might cause or perpetuate the CLBP experience. Most studies of brain function are small and cross sectional and some of the variability between findings is the result of factors such as divergent methodology and lack of statistical power. [3] [4] However, it is the cortical changes that make the rehabilitation more difficult, and may contribute to the problem, as well as failure of common treatment approaches. [3] Moseley et al had done a study on CRPS patients that were characterized by cortical dysfunction. They found CRPS1 patients took longer to recognize the hand that corresponded to their affected hand and concluded that on-line nociceptive input disrupts the internal body schema. Also, impact on higher order motor activity such as motor planning is possibly due to guarding type mechanism occurring because of pain. The mechanism of effect, although not very clear, may involve sequential activation of cortical pre-motor and motor networks, or sustained and focused attention to the affected limb, or both. Therefore, the study supported the use of graded motor imagery program in CRPS patients. [5] A systemic review and meta-analysis done by K. Jane Bowering et al, of GMI versus usual physiotherapy care favored GMI in reducing chronic pain. The review suggested that altered sensory cortical organization when targeted to sensory discrimination training had clinical benefits. GMI was developed to directly target the cortical disruptions like —disrupted processing of stimuli delivered to healthy body parts held in the affected space, the abnormality of the perceived size of the painful body part, and poor voluntary movement and motor imagery performance.[6] Dr. A. John Harris explained from his study of cortical origin of pathological pain that, S1 reorganization distorts the internal body maps that the brain uses to control movement, and this distortion causes incongruence between motor commands and sensory feedback, hence causing pain in the same way that incongruence between vestibular and visual sensation results in motion sickness.[13]

Patients' problem was resistant to multiple forms of treatment, wherein, after participating in the program sensorimotor retraining improved their clinical status. Proved to be clinically viable, required simple equipment and it could be replicated at home.

V. Conclusion

We confirm our hypothesis, that disruption of cortical structure and function maybe a feature of chronic mechanical low back pain and we concluded that added effect of sensorimotor training is effective in the reduction of pain, pain interference with daily activities and self-reported disability. Limitations of the study was the small sample size and no follow up of patients' post- treatment to see its long-term effects. Also, no follow up of patients were done to see the long-term effect of sensorimotor training.

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