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Original Research Article

Effect of Transdermal Magnesium Oil Application along with Conventional Protocol verses Conventional Protocol on Kinesiophobia in Chronic Low Back Pain Patients

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ABSTRACT

Background: Chronic low back pain (CLBP) is a common musculoskeletal disorder that profoundly impacts mobility, everyday activities, and overall quality of life. Effective rehabilitation for individuals with CLBP is significantly hampered by kinesiophobia, or the fear of movement brought on by pain-related anxiety. Magnesium is essential for neuromuscular function and has helped relax muscles and minimize pain. The purpose of this study was to assess the effect of transdermal magnesium oil administration, when combined with conventional physiotherapy, on pain, motion, muscle activation, disability, and kinesiophobia in patients with CLBP.

Methods: A comparative study involving 30 participants, divided into 2 groups of 15 each. Group A (Conventional group) received steam and traditional exercises. Group B (Experimental group) received moist heat in the form of steam, followed by transdermal Magnesium oil application and traditional exercises. The intervention consisted of 12 sessions over 2 weeks. Conventional exercises included lower-limb strengthening, pelvic tilts, glute bridges, crunches, lower abdominal strengthening, dead bug, and therapy ball strengthening to improve flexibility, mobility, and stability of the spine and surrounding musculature. Outcome measures like Numerical Pain Rating Scale (NPRS), Oswestry Disability Index (ODI), Tampa Scale of Kinesiophobia (TSK), EMG peak value for lumbar extensor activation, and lumbar and pelvic mobility were assessed pre-intervention and post-intervention for both groups, and the data were analysed using SPSS software Version 29.

Result: Both groups demonstrated improvement in all the outcome measures post-intervention; however, the experimental group showed significant improvement in lumbar flexion range, NPRS on activity, TSK score, ODI, and EMG peak values.

Conclusion: In patients with CLBP, the combination of transdermal magnesium oil and conventional physiotherapy resulted in significant reductions in Kinesiophobia. These results provide validity to the apparent benefit of transdermal magnesium supplementation for the treatment of CLBP.

KEY WORDS: Chronic Low Back Pain, Kinesiophobia, Magnesium oil, Muscle activation.

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INTRODUCTION

Low back pain is the most common musculoskeletal condition and studies prove that 32% of patients with acute low back pain develop chronic low back pain eventually over a period of 6 months, leading to limitations like sitting discomfort, bending difficulties and lifting struggles causing difficulties in daily life, work responsibilities and movement limitations which causes loss of productivity and disability [1-3]. Chronic low back pain recurrence is a serious concern because 69% of patients experience relapses within a year after their symptoms have resolved [4]. Prolonged kinesiophobia and unresolved neuromuscular deficits are frequently the cause of this high recurrence, as these factors encourage fear-avoidant behaviors, functional deconditioning, and recurrent pain cycles. 50-70% of patients suffering from chronic pain develop Kinesiophobia, which is closely associated with poor quality of life, decreased physical activity, disability, and increased pain severity [5]. Kinesiophobia is persistent in chronic low back pain patients, and hence, there is a need to find alternative treatment methods to address it. Magnesium, a trace but important mineral in the human body, plays a role in over 300 enzymatic reactions across the body's various systems [6]. The neuromuscular system plays a positive role in pain modulation and helps relax muscles during the muscle contraction-relaxation cycle [7]. Whereas in the nervous system, it plays a role in central desensitization. This study is therefore designed to assess the effect of magnesium on Kinesiophobia [8].

This study aimed to assess the effect of transdermal magnesium oil when used as an adjunct to conventional therapy on kinesiophobia in chronic low back pain patients.

METHODOLOGY

It was an interventional comparative study involving 30 participants with chronic low back pain, divided into two groups using an alternate method of simple random sampling, conducted over a period of 6 months in the Physiotherapy OPD at Nanavati Max Super Specialty Hospital, Mumbai, India.

Both males and females in the age group of 18-50 years, suffering from low back pain for more than 12 weeks, were included in the study, and patients who have undergone derangement such as listhesis, spine surgery, or lumbosacral fracture were excluded.

Outcome measures used were, Numerical Pain Rating Scale (NPRS) at rest and on activity, Oswestry Disability Index (ODI), Tampa Scale of Kinesiophobia (TSK), EMG peak value to measure muscle activation of lumbar extensors, pelvic inclination, Modified Schober's test to measure lumbar flexion and extension, fingertip to floor distance test to measure lumbar side flexion, sit and reach test to measure flexibility.

The intervention consisted of 12 physiotherapy sessions over 2 weeks. The conventional group received a steam application on the lower back for 10 minutes, followed by traditional exercises. The experimental group received steam for 10 minutes on the lower back, followed by four sprays of magnesium oil over the lumbar extensors, and then traditional exercises. Approximately 450 mg of Magnesium chloride oil was used (4 sprays). Magnesium chloride was used because of its higher absorption rate and bioavailability, and because it is frequently recommended for topical treatment over other forms of magnesium salts. Magnesium was applied after steam for better absorption. The transdermal mode of application was used to improve muscle performance and relieve pain without having adverse effects on the gastrointestinal tract [9].

A rehabilitation protocol was implemented for 12 sessions targeted to enhance core stability, lower-limb mobility, and functional control. Sessions 1 and 2 employed low-load, isolated range-of-motion and isometric activation exercises—including ankle dorsiflexion/plantar flexion and rotations; isometrics targeting the hamstrings, quadriceps, gluteals, adductors, abductors, paraspinals; transverse abdominis engagement; straight-leg raises; side-lying hip abduction; cat–camel; lumbar extension; and bridging- highlighting basic

mobility and neuromuscular recruitment. In sessions 3 and 4, progression included time-based loading via 5-second hold, pelvic control drills (anterior/posterior tilts, left/right hikes), lumbar extensions on hands, and transitional movements such as the lion's stretch. Sessions 5 and 6 introduced external resistance with weight cuffs during straight-leg raises and hip abduction, along with dynamic core exercises like bird-dog, superman, and bilateral oblique activation. Sessions 7 and 8 progressed to unstable-surface neuromuscular training on a therapy ball—ball bouncing, pelvic tilts, bird-dog, lumbar side flexion/rotation, dead-bug isometrics, and supported full squats— to enhance proprioception and trunk stability. Sessions 9 and 10 focused on coordination and endurance by integrating dead-bug exercises and crunches, shoulder flexion with knee extension on the ball, upper-limb PNF patterns, and prone planks. Finally, Sessions 11 and 12 incorporated increased complexity with weighted shoulder flexion and knee extension on the ball, forward bending, resisted lifts, stability trainer perturbations, full squats, and bird-dog exercises on the ball, thereby culminating in dynamic, whole-body control under load. This methodical transition from isolated, isometric activation to dynamic training is consistent with well-established rehabilitation frameworks that support functional integration, load, and complexity increases over time.

RESULTS

The data were analysed using the Statistical Package for the Social Sciences (SPSS) Version 29. The normality test showed that the baseline values of both groups followed a normal distribution, suggesting the groups were homogeneous. Intergroup analysis was performed using the 'Unpaired t-test' to compare the post-intervention improvements between the two groups. The mean age in participants of group A was 36.93±11.26, and in participants of group B, it was 34.73±11.37. Females were found to be affected more than males, with a ratio of 11:4 in both groups.

NPRS on activity, lumbar flexion, and ODI showed a statistically significant improvement ($p < 0.05$) at the 95% confidence interval in the experimental group compared with the conventional group.

Table 1 and Graph 1: Intergroup comparison of NPRS on activity post-intervention

Table 2 and Graph 2: Intergroup comparison of lumbar flexion post-intervention

Table 3 and Graph 3: Intergroup comparison of Oswestry Disability Index (ODI) scores post-intervention.

Table 1: Intergroup comparison of NPRS on activity post-intervention

Post Intervention	Group A	Group B	P value
NPRS Activity	3±1.19	2±1.13	0.02

Figure 1: Intergroup comparison of NPRS on activity post-intervention.

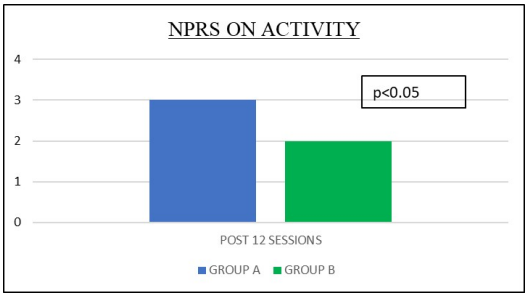

Table 2: Intergroup comparison of lumbar flexion post-intervention.

Post Intervention	Group A	Group B	P value
Lumbar Flexion	4.9±0.66	5.63±0.61	0.004

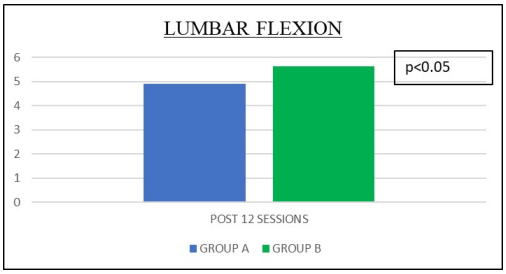

Figure 2: Intergroup comparison of lumbar flexion post-intervention.

Table 3: Intergroup comparison of Oswestry Disability Index (ODI) scores post-intervention.

Post Intervention	Group A	Group B	P value
ODI	9.53±6.39	5.47±3.66	0.04

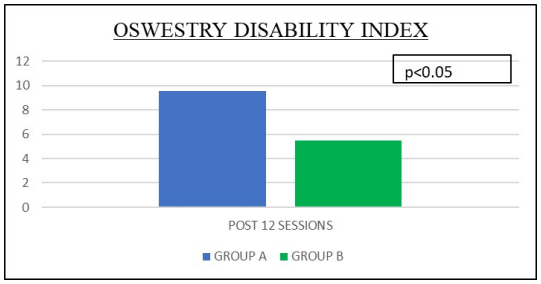

Figure 3: Intergroup comparison of Oswestry Disability Index (ODI) scores post-intervention.

DISCUSSION

This study found significant improvement in Muscle activation in the group receiving transdermal magnesium oil application, consistent with the study by Carvil et al. In 2010, Al highlighted the importance of magnesium as a cofactor in enzymatic processes underlying muscle contraction and relaxation. Magnesium is necessary for neuromuscular transmission and muscle excitability because it controls the passage of calcium and potassium ions across cell membranes [7]. The inability of the abdominal muscles to contract effectively due to tight lumbar extensors and stretched abdominal muscles impacts posture and lumbo-pelvic rhythm. The lumbar extensors showed greater relaxation following magnesium application, with a notable improvement in lumbar flexion, especially in the experimental group. By altering calcium dynamics in the sarcoplasmic reticulum of muscle fibers, magnesium may promote muscular relaxation when applied topically. This results in a decrease in tonic contraction of the paraspinal muscles. These results are reliable and in line with the findings of Shin HJ et al. (2020), who supported magnesium's role in reducing muscle hyperactivity and stiffness, and Carvil et al. (2010), who suggested that magnesium supplementation improves musculoskeletal flexibility [7,8].

The participants' reduced pain intensity is primarily due to magnesium oil's action as an N-methyl-D-aspartate (NMDA) receptor antagonist. Both central

sensitization and the transmission of pain depend on NMDA receptors. In chronic pain disorders, persistent activation of the NMDA receptor increases calcium influx, which, in turn, promotes neuronal excitability, hyperalgesia, and allodynia. Magnesium prevents excessive calcium from reaching the dorsal horn neurons in the spinal cord by blocking these receptors. One of the leading causes of persistent discomfort in chronic low back pain (CLBP) is central sensitization, which this approach reduces. This analgesic activity is in line with the findings of Shin HJ et al. (2020), and Parekh et al. (2024) further validated these findings [8,10].

Numerous personality traits, such as anxiety, depression, and fear-avoidant behavior, are frequently linked to chronic low back pain. According to studies, these psychological factors have a significant impact on how people perceive pain, how disabled they are, and how well they respond to treatment. High levels of anxiety and depressed symptoms are commonly reported by people with CLBP, which can lead to decreased motivation, inadequate coping, and increased pain behavior (Pande, 2004) [11]. The current study found that there was a clinically significant improvement in Kinesiophobia in the experimental group although statistically significant difference was not found, this may be because 450 mg of magnesium had to be given topically twice a day as per the recommended dosage, but since the patient took treatment once a day, 450 mg of magnesium in the form of 4 sprays were given only once in a day. This reduction in kinesiophobia scores (as determined by the Tampa Scale for Kinesiophobia, or TSK), is an important result because one of the main psychological obstacles to rehabilitation in CLBP is a dread of mobility.

This result can be explained, in part, by magnesium's effect on the Hypothalamic-Pituitary-Adrenal (HPA) axis. Because it supports adrenal gland function and regulates cortisol release, magnesium is essential for stress regulation. Elevated cortisol levels and compromised stress responses are the results of HPA axis dysregulation, which is frequently observed in chronic stress and pain situations. Boyle (2017) discovered that taking magnesium supplements helped to stabilize the HPA axis and lessen stress and anxiety symptoms [12]. As a result, magnesium's anxiolytic properties may help reduce fear-avoidant behavior and enhance overall psychological health.

Neurotransmitters such as gamma-aminobutyric acid (GABA), an inhibitory neurotransmitter that lowers neuronal excitability, are synthesized and regulated by magnesium [13]. The central nervous system is calmed by increased GABAergic activity, which reduces

anxiety and encourages relaxation. The experimental group's lower TSK ratings, which show both increased physical function and a favorable change in psychological attitude toward mobility and rehabilitation, may be further explained by this neurochemical effect.

Transdermal magnesium therapy offers numerous advantages in the treatment of chronic low back pain, as evidenced by the general improvement in physical performance, decrease in pain, and alleviation of psychological anguish. Transdermal administration bypasses the gastrointestinal tract, which may improve bioavailability and reduce gastrointestinal side effects, such as diarrhoea or poor absorption, compared with oral supplementation [9].

Additionally, applying this method across areas of joint limitation or muscle tightness may result in more localized benefits.

Transdermal magnesium oil application, as a supplement to traditional physiotherapy, may provide a comprehensive strategy for treating persistent low back pain, given these findings. In addition to addressing pain and muscle stiffness, it improves mobility, supports general functional restoration, and helps recover underlying Kinesiophobia.

Limitations: Serum magnesium levels were not measured, as only 1% of the body's magnesium is detectable in the blood.

Future Scope of Study: Future scope is to assess the role of transdermal application of Magnesium in chronic musculoskeletal conditions.

ABBREVIATIONS

LBP: Low Back Pain

CLBP: Chronic Low Back Pain '

ODI: Oswestry Disability Index

TSK: Tampa Scale of Kinesiophobia

EMG: Electromyography

GABA: Gamma- aminobutyric acid

NMDA: N-methyl D-Aspartate

HPA: Hypothalamo-pituitary-adrenal axis

MDC: Minimal Detectable change

NPRS: Numerical Pain Rating Scale

OPD: Outpatient Department

CONCLUSION

Transdermal Magnesium oil, when added to a conventional physiotherapy protocol, showed greater improvements in muscle activation and reduction in Kinesiophobia in Chronic low back pain patients compared to the Conventional group.

Authors Contributions

Dr. Khyati Thakker (PT): contributed towards the selection of the topic, the research process, the research design, the data collection, and the manuscript drafting.

Dr. Mansi Bhartiya (PT): Research design, statistical research analysis, discussion, and editing.

Prof. Dr. Ali Irani: Research design, discussion.

Conflicts of interest: None

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