Impact of McKenzie Extension Exercise Approach on Patients with Chronic Low Back Pain with Radiculopathy: A Randomized Controlled Trial

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Abstract

Background: Despite extensive research, the issue of chronic low back pain management still constitutes a matter of challenging. McKenzie approach is widely used as a therapeutic modality. Although it constitutes a promising classification-based treatment, the scientific evidence for its effectiveness is still unclear. Objective: This study was conducted to assess the impact of McKenzie extension exercise approach on patients with chronic low back pain with radiculopathy. Subjects: Thirty patients of both genders with confirmed unilateral L5–S1 lumbosacral radiculopathy who demonstrating centralization with lumbar extension at intake, randomly assigned to intervention or control group. Methods: The control group (n = 15) received conventional physical therapy, whereas the intervention group (n = 15) received McKenzie extension exercise approach In addition to conventional physical therapy Main outcome measures: Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), and H-reflex amplitude and latency were assessed for all patients at baseline and after 6 weeks of intervention. Results: There were significant differences in the two groups with more decline of both VAS and ODI and increase in of H-reflex amplitude in group A relative to group B. However regarding H-reflex latency, Group A experienced significant declines (t = 5.49; P = 0.007), while Group B did not exhibit any change. Between-group differences were noteworthy regarding H-reflex amplitude (t = 2.17; P = 0.036) and latency (t = 7.53; P < 0.001). Conclusion: McKenzie extension exercise approach is a more effective treatment than conventional physical therapy for patients with chronic LBP with radiculopathy who demonstrating centralization with lumbar extension.

Key words: Chronic Low Back Pain; McKenzie Extension Exercise Approach; Radiculopathy; Effectiveness; Randomized Controlled Trial.

INTRODUCTION

Low back pain (LBP) is one of the most widely recognized conditions that debilitating people’s functional capacity in activities of daily living and at work, as well as their general wellbeing and quality of life [1]. Around 80% of the population experience spinal pain sooner or later in life [2]. It represents an especially socio-economic problem due to the costs associated with repeated treatments, long-term absence from work and need for social support [3]. Disc-related disorder of the spine is the common cause of LBP and the most widely recognized reason for radiculopathy [4].

Radiculopathy is a typical clinical issue that mainly involves L5 and S1 nerve roots. It occurs in around 3-5% of the population with men and women are influenced similarly [5]. It might emerge from disc herniation, spinal stenosis, or post-operative scarring. It emanates down the leg in a dermatomal pattern, where the unilateral leg pain is frequently described by the patient as worse than the back pain [6].

Although various previously published reviews have dealt with different therapeutic modalities of LBP, the evidence of their efficacy is highly inconclusive [4, 7]. Inconsistency of established diagnoses and implemented protocols of management points to the importance of the issue in question. Despite extensive research, the issue of chronic LBP management still constitutes a matter of challenging [7, 8].

Several treatment modalities have been perceived to date. An undeniably popular conceptual system is that of Robin McKenzie, who believes that the foremost reason for back pain is disc disease manifested by
abnormal mechanics resulting from the consequences of migration of the intact nucleus within the disc [9].

McKenzie's Classification method follows a comprehensive clinical examination, together with the evaluation of patient's symptomatic response to different loading strategies applied to the spine. Findings from this examination decide low back pain to be one of three syndromes: derangement syndrome; dysfunction syndrome; or postural syndrome. The main component of treatment in the McKenzie method is exercise, which comprises of sustained postures or repeated movements similar to the loading strategies used for the evaluation [10].

The centralization phenomenon is the most important pattern of pain response observed in McKenzie's assessment, as well as the most studied feature of the McKenzie method [11, 12]. Centralization is defined as the situation in which referred pain arising from the spine is reduced and transferred to a more central position when movements in specific directions are performed (also called directional preference). Although it is generally agreed that patients likely to benefit from an extension exercise approach are those who experience centralization with lumbar extension movements, most previous studies have not incorporated this hypothesis into their design or inclusion criteria [13].

Patients' feedback of pain perception is an essential guide for treatment in McKenzie method. As pain is a subjective measure, a need for a more objective method for evaluating the efficacy of the McKenzie extension exercise approach remains an area of intense research. H-reflex in particular provides an objective assessment of nerve root compression or entrapment. Moreover, it is reported to be an objective tool in measuring the degree of compression and decompression on the compromised nerve root in patients with lumbosacral radiculopathy [14].

Although the McKenzie method is a promising classification scheme to be implemented in the management of LBP, the scientific evidence to support its effectiveness is still scarce. Therefore, the aim of our randomized-controlled trial was to assess the impact of McKenzie extension exercise approach on patients with chronic low back pain with radiculopathy who demonstrating centralization with lumbar extension.

MATERIALS AND METHODS

Thirty patients of both genders with the diagnosis of chronic low back with radiculopathy, ranged in age from 35 to 50 years, were screened and randomly assigned to either Control or Intervention group to participate into this randomized-controlled trial. They were recruited from outpatient clinic of the Faculty of Physical Therapy, Cairo University, to participate in this study.

Patients were selected to be enrolled into this study after they had fulfilled the inclusion criteria of the study: LBP with L5-S1 radiculopathy that was confirmed clinically and radiologically through magnetic resonance imaging, pain extending distal to the inferior gluteal folds on lower extremity, the centralization phenomenon determined by using active movements testing had to be present, and symptoms more than 3 months. Patients had provided informed consent for participation in the study and for publication of the results. This study was approved by the Ethics Committee for Scientific Research of the Faculty of Physical Therapy, Cairo University.

Subjects were excluded if they had serious spinal pathology (e.g., fracture, tumor, inflammatory and infectious diseases), neurological defects (e.g., altered sensation, muscles weakness, and altered deep tendon reflexes), serious cardiovascular diseases, previous back surgery, or pregnancy.

Initial medical screening was performed for every patient by a neurologist and clinical history was recorded for all participants. Study protocol and the objectives of the study were altogether explained to all participants.

Design of the study

The study was a randomized-controlled trial. Patients who fulfilled the inclusion criteria of the study were randomly assigned to either group A, the Intervention group, who received McKenzie extension exercise approach in addition to conventional physical therapy for chronic LBP with L5-S1 radiculopathy, or group B, the control group, who received conventional physical therapy only.

Randomization was done by opening an opaque envelope prepared by an independent individual using random number generation.

Instrumentation

For evaluation

Visual analogue scale (VAS)

To verify the efficacy of intervention, participants were assessed with the visual analogue scale (VAS) at the baseline (prior to the intervention) and 24 hours after completing the treatment. The VAS is a scale that assesses the levels of pain intensity perceived by the patient using a 10-point scale (varying from 0 to 10), in which 0 represents “no pain” and 10 represents the “worst possible pain” [15].

Oswestry Disability Index (ODI)

The degree to which the dysfunction of the lumbar spine limited the performance of the activities of daily living was determined with the Oswestry Pain Index [16]. The index is a self-report questionnaire of the subject's perceived disability related to LBP and consists of physical and social components. The survey was conducted twice, prior to and after intervention.

Nihon Kohden Neuropack S1 Electromyography

Neuropack S1 MEB-9400K Electromyography (1-31-4 Nishiochïai, Shinjuku-ku, Tokyo 161-8560, Japan) was
used for all nerve stimulation and reflex recording. Monopolar constant current stimulation with 1-millisecond square waves was applied to the skin overlying the tibial nerve at 5-second intervals. The electrical activity associated with the reflexes was monitored on an oscilloscope, and the data were stored on a computer disk for further analysis. H-reflex amplitudes (peak-to-peak measurement) and latency were measured on a Neuropack S1 MEB-9400K digital oscilloscope.

Outcome measures

Both groups underwent an identical battery of tests: baseline and after 6 weeks of intervention. The evaluated parameters included VAS, ODI, and H-reflex amplitude and latency.

Firstly, data on the subjects’ characteristics was collected in the first session including resting heart rate (HR) (beats/min) and resting respiratory rate (cycles/min). Weight (kg) was measured to the closest 0.1 kg using a standard weight scale. Height was measured to the closest 0.1 cm with a standard height scale. BMI (kg/m2) was estimated as weight in kilograms divided by squared height in meters.

Procedures

Evaluative Procedures

H-reflex recording protocol

Subjects were positioned prone in quite room on a wooden padded table to eliminate environmental variations on the motor neuron excitability. The head was maintained in mid position to control the possible effects of asymmetrical tonic neck reflex [17]. On the selected leg, the hip was placed in approximately 0 degrees of extension and abduction, the knee was placed in 20 degrees of flexion by placing a small cushion under the ankle to relax the gastrocnemius muscle and reduce any depressive influence on the H-reflex. The ankle joint was freely positioned in planter flexion outside the plinth [18].

Bipolar surface recording electrodes coated with a special electro-conductive gel to ensure good electrical coupling were placed approximately 3 to 5 cm apart over the dorsal medial surface of the posterior calf, inferior to the belly of the gastrocnemius muscle. The reference electrode was placed equidistant between the stimulating and recording electrodes to minimize the stimulus artifact [19]. In the popliteal fossa, a 1-millisecond stimulation was applied to the skin over the tibial nerve, and proper cathode positioning was determined when (1) the direct motor reflex (M-wave) and H-reflex (H-wave) displayed similar wave configurations, (2) the H-wave was evoked before the M-wave, and (3) the least amount of current was required to elicit an H-reflex. The stimulating intensity was increased until a maximal H-reflex was observed, after which the on-line average of 10 H-reflexes was recorded. While observing the on-line average of the maximal H-reflex, the intensity was decreased until 50% of the maximal H-reflex was obtained. At this stimulating intensity, a subject’s baseline H-reflex was established by averaging 10 stimulations of the tibial nerve [20].

Mechanical evaluation (centralization phenomenon)

In testing the centralization phenomenon during the mechanical assessment the exact site and change in the location of low back and referred pain was recorded. The patient was classified as a centralizer if the pain was found to move from the periphery towards the spinal midline and remained more central in response to a specific direction of testing. If there was midline spine pain only and it was abolished and remained so this too was classified as centralization. The movements and positions used to determine centralization are highly standardized and consist of standing extension, prone extension, and asymmetric prone lumbar extension [10]. As recommended, Pain responses observed during the initial assessment were limited to proximal changes in pain location without consideration of symptom intensity and all changes in pain location were measured using body diagrams and a numeric body diagram overlay template tool [21, 22].

Each patient was instructed by the shade in all areas on the body diagram where he or she was experiencing LBP and referred symptoms. Body diagrams were completed in standing before and after the physical examination. After the evaluation, the numeric overlay template was applied to the patient’s body diagrams to document the most distal pain location scores between 1 and 6. The higher scores indicate a more distal pain location (i.e., 1 equals central low back, whereas 6 represents referred spinal symptoms into the foot) [22].

Therapeutic Procedures

Control Group

Participants in group B received conventional physical therapy in form of thermotherapy (e.g., infrared for 15 minutes), TENS for 30 minutes, and strengthening exercises to improve isolated contractions of the deep abdominal muscles (e.g., transversus abdominus) and primary stabilizers of the spine (e.g., oblique abdominal, multifidus, quadratus lumborum, and erector spiniae muscles) [23].

Intervention Group

In addition to conventional physical therapy, group A received McKenzie extension exercise approach. This approach comprise a set of sagittal extension exercises that were progressed as tolerated through to patient overpressure to gain full range as static prone positioning, lying prone in extension (prone on elbows), extension in lying (prone on hands with elbow extension), extension in lying with patient overpressure, and standing extension. Each exercise was done in 3 sets per session, each set had 10 repetitions with 1 minute rest between the sets [10]. The intervention protocol was three times per week (on nonconsecutive days) for 6 weeks.

Data collection
For each group, both demographic and clinical characteristics of patients [Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), and H-reflex amplitude and latency] were collected pre and post intervention.

**Statistical Analysis**

*Descriptive statistics for all parameters in the form of Mean and standard deviation of [Demographic and clinical characteristics; VAS, ODI, and H-reflex amplitude and latency] and Percentage of change in VAS, ODI, and H-reflex amplitude and latency post intervention were evaluated.*

*Inferential statistics in the form of Paired t-test to examine the changes in VAS, ODI, and H-reflex amplitude and latency pre and post intervention in each group and Independent t-test to compare between the two groups pre and post intervention. The level of significance was set at \( P \leq 0.05 \) [24].*

**RESULTS**

*Demographic and clinical characteristics of patients in both groups*

Demographic and clinical characteristics of patients are given in Table 1. The groups were homogenous with regard to mean age, gender, BMI, and average duration of illness. Clinical parameters of the study; VAS, ODI, and H-reflex amplitude and latency were also well balanced in both groups at baseline (\( P > 0.05 \) for all variables).

**VAS, ODI, and H-reflex amplitude and latency in the two groups pre and post intervention**

Pre and post intervention analysis revealed that, clinically the patients in group A treated with McKenzie extension exercise approach in addition to conventional physical therapy, improved pain slightly more (mean VAS from 6.60 ± 1.68 to 3.067 ± 1.87, with a -53.53% change) as compared with the patients in group B treated with conventional physical therapy (mean VAS from 6.33 ± 1.75 to 3.467 ± 1.50, with a -45.22% change), while statistically both interventions were equally effective.

Functionally results revealed that, clinically the patients in group A improved function slightly more (mean ODI from 22.47 ± 10.34 to 8.80 ± 6.06, with a -60.83% change) as compared with the patients in group B (mean ODI from 19.67 ± 8.76 to 10.73 ± 6.16, with a -45.44% change), while statistically both interventions were equally effective in management of functional disability as assessed by ODI.

Regarding H-reflex amplitude and latency, Group A experienced significant increases in H-reflex amplitude slightly more (mean H-reflex amplitude from 3.11 ± 0.53 μv to 4.12 ± 0.87 μv, with a 32.47% change) as compared with patients in group B (mean H-reflex amplitude from 3.08 ± 0.42 μv to 3.40 ± 0.53 μv, with a 10.38% change).

However regarding H-reflex latency, Group A experienced significant declines (\( t = 5.49; \ P = 0.007 \)) in latency from 32.11 ± 0.88 msec. to 31.040 ± 0.90 msec. with a -3.33% change, while Group B did not exhibit any change. Results are presented in Table 2 and 3.

**VAS, ODI, and H-reflex amplitude and latency in the two groups Post-intervention**

Between-group differences were noteworthy regarding H-reflex amplitude (\( t = 2.17; \ P = 0.036 \)) and latency (\( t = 7.53; \ P < 0.001 \)). However, regarding VAS and ODI, there were non-significant statistical differences between the two groups post-intervention. Results are presented in table 4.

**Table 1: Baseline demographic and clinical characteristics of patients in both groups (Mean ± SD)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group A (N=15)</th>
<th>Group B (N=15)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>41.73 ± 4.62</td>
<td>41.47 ± 4.35</td>
<td>0.19</td>
<td>0.849</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162.08 ± 4.87</td>
<td>162.32 ± 5.72</td>
<td>0.13</td>
<td>0.893</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>91.28 ± 9.42</td>
<td>93.32 ± 14.23</td>
<td>0.47</td>
<td>0.640</td>
</tr>
<tr>
<td>Gender (male)</td>
<td>53.33%</td>
<td>60.00%</td>
<td>0.53*</td>
<td>0.440</td>
</tr>
<tr>
<td>Body Mass Index (Kg/m²)</td>
<td>34.82 ± 3.43</td>
<td>35.26 ± 3.38</td>
<td>0.35</td>
<td>0.725</td>
</tr>
<tr>
<td>Duration of illness (months)</td>
<td>4.10 ± 0.68</td>
<td>3.90 ± 0.87</td>
<td>0.65</td>
<td>0.430</td>
</tr>
<tr>
<td>VAS</td>
<td>6.60 ± 1.68</td>
<td>6.33 ± 1.75</td>
<td>0.40</td>
<td>0.690</td>
</tr>
<tr>
<td>ODI</td>
<td>22.47 ± 10.34</td>
<td>19.67 ± 8.76</td>
<td>0.89</td>
<td>0.380</td>
</tr>
<tr>
<td>H-reflex amplitude (μv)</td>
<td>3.11 ± 0.53</td>
<td>3.08 ± 0.42</td>
<td>0.76</td>
<td>0.392</td>
</tr>
<tr>
<td>H-reflex latency (msec.)</td>
<td>32.11 ± 0.88</td>
<td>31.82 ± 0.89</td>
<td>0.96</td>
<td>0.354</td>
</tr>
</tbody>
</table>

\( \text{SD} = \text{Standard Deviation;} \ \text{VAS} = \text{Visual analogue scale;} \ \text{ODI} = \text{Oswestry Disability Index} \)

* the value is calculated using the \( \chi^2 \)-test; Level of significance at \( P \leq 0.05 \)
Table 2: VAS, ODI, and H-reflex amplitude and latency in Group A pre and post-intervention

<table>
<thead>
<tr>
<th>Variables</th>
<th>McKenzie Extension Approach group (A) (N=15)</th>
<th>Pre training</th>
<th>Post training</th>
<th>Percentage of Change</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td></td>
<td>6.60 ± 1.68</td>
<td>3.06 ± 1.87</td>
<td>-53.53%</td>
<td>11.34</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>ODI</td>
<td></td>
<td>22.47 ± 10.34</td>
<td>8.80 ± 6.06</td>
<td>-60.83%</td>
<td>10.31</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>H-reflex amplitude (μv)</td>
<td></td>
<td>3.11 ± 0.53</td>
<td>4.12 ± 0.87</td>
<td>32.47%</td>
<td>6.55</td>
<td>0.002*</td>
</tr>
<tr>
<td>H-reflex latency (msec.)</td>
<td></td>
<td>32.11 ± 0.88</td>
<td>31.04 ± 0.90</td>
<td>-3.33%</td>
<td>5.49</td>
<td>0.007*</td>
</tr>
</tbody>
</table>

SD = Standard Deviation; VAS = Visual analogue scale; ODI = Oswestry Disability Index

Table 3: VAS, ODI, and H-reflex amplitude and latency in Group B pre and post-intervention

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control Group (B) (N=15)</th>
<th>Pre training</th>
<th>Post training</th>
<th>Percentage of Change</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td></td>
<td>6.33 ± 1.75</td>
<td>3.46 ± 1.50</td>
<td>-45.22%</td>
<td>12.32</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>ODI</td>
<td></td>
<td>19.67 ± 8.76</td>
<td>10.73 ± 6.16</td>
<td>-45.44%</td>
<td>8.75</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>H-reflex amplitude (μv)</td>
<td></td>
<td>3.08 ± 0.42</td>
<td>3.40 ± 0.53</td>
<td>10.38%</td>
<td>1.09</td>
<td>0.038*</td>
</tr>
<tr>
<td>H-reflex latency (msec.)</td>
<td></td>
<td>31.82 ± 0.89</td>
<td>31.67 ± 0.67</td>
<td>-0.47%</td>
<td>0.77</td>
<td>0.288</td>
</tr>
</tbody>
</table>

SD = Standard Deviation; VAS = Visual analogue scale; ODI = Oswestry Disability Index

Table 4: VAS, ODI, and H-reflex amplitude and latency in the two groups Post-intervention

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group(A)</th>
<th>Group(B)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>3.06 ± 1.87</td>
<td>3.46 ± 1.50</td>
<td>0.56</td>
<td>0.582</td>
</tr>
<tr>
<td>ODI</td>
<td>8.80 ± 6.06</td>
<td>10.73 ± 6.16</td>
<td>0.78</td>
<td>0.448</td>
</tr>
<tr>
<td>H-reflex amplitude (μv)</td>
<td>4.12 ± 0.87</td>
<td>3.40 ± 0.53</td>
<td>2.17</td>
<td>0.036*</td>
</tr>
<tr>
<td>H-reflex latency (msec.)</td>
<td>31.04 ± 0.90</td>
<td>31.67 ± 0.67</td>
<td>7.53</td>
<td>&lt; 0.001*</td>
</tr>
</tbody>
</table>

SD = Standard Deviation; VAS = Visual analogue scale; ODI = Oswestry Disability Index

DISCUSSION

The objective of our randomized-controlled trial was to investigate the impact of McKenzie extension exercise approach on patients with chronic LBP with radiculopathy who demonstrating centralization with lumbar extension. Findings demonstrates that group A who received McKenzie extension exercise approach in addition to conventional physical therapy showed more improvement with regard to the clinical and neurophysiological parameters based on the decrease in leg and back pain scores, disability and latency of H-reflex and increase in the amplitude of H-reflex.

Classifying patients with low back pain into homogeneous treatment subgroups to help direct treatment decisions and improve prognosis and patient outcomes has been recognized as an important research and clinical priority [21, 22]. The present study examined a more homogenous sample i.e. those with symptoms extending to the buttocks or more
peripherally who demonstrate centralization with extension movements at intake.

The efficacy for using CEN as a classification criterion was supported by Browder et al. [25]. Their results showed improved outcomes for patients classified into an extension-oriented treatment subgroup who received extension exercise and mobilization compared to stabilization strengthening exercises during rehabilitation. Long et al [26] reported that patients with lumbar syndromes who were prescribed exercises matched to their DP determined at baseline demonstrated clinically important improvements in pain and function compared to similar patients whose exercise prescription was not matched to their DP.

The McKenzie extension exercise approach group showed more reduction of pain and disability. The centralization effect of McKenzie technique may account for this improvement. A study was done to find the effectiveness of McKenzie exercises in patients with lumbar radiculopathy; thirty four patients were recruited into two groups of one with McKenzie and one with joint mobilization. McKenzie group demonstrated significantly greater improvements in pain and function after three sessions [27]. Similarly studies done by Browder et al. [25], Goldby [28], Nwuga [29], Petersen et al. [30], Sakai et al. [31], and Udermann et al. [32] support the result of this study.

McKenzie back extension is a progression from lying prone to prone on hand with over pressure. These back extensions exercises is assumed to have a greater effect in moving the disc content anteriorly away from spinal nerves pathway and to improve the alignment of the lumbar spine at L5-S1. This movement is believed to reduce radicular symptoms of patient with derangement and also doing repeated extension exercise will help in maintaining and improving spinal extension [33].

In an observational study Rasmussen et al. [34] the rates of lumbar disc surgery before and after implementation of two spine rehabilitation programs focused on the McKenzie method were compared to the rates elsewhere in Denmark among sciatica patients. The annual rate of all lumbar discectomies decreased by approximately 50% and elective first time discectomies by two thirds in the catchment area of the McKenzie clinics, while the surgery rates remained unchanged during the same period in the rest of Denmark.

Neurophysiologically, Group A experienced significant increases in H-reflex amplitude slightly more as compared with patients in group B. However regarding H-reflex latency, Group A experienced significant declines while Group B did not exhibit any change. Between-group differences were noteworthy regarding H-reflex amplitude and latency. Restoring the normal alignment for the nervous system and decreasing the abnormal stresses and strains on neural elements are the likely explanation for significant improvement in H-reflex parameters.

The unique contribution of our study is that it objectively assessed the impact of McKenzie extension approach on H-reflex parameters, which to our knowledge has not been previously reported except for one study conducted by Abdulwahab et al. [35] that studied the effect of single session of 30 repetition back extension exercises on H-reflex in patients with lumbar radiculopathy and concluded that there is no positive neurophysiological effect on the compromised L5-S1 spinal nerve root. The reasons for these differences may be related both to the initial selection of patients i.e. sample heterogeneity and to brief interventions, where the treatment duration might not have been adequate for effects to occur.

The limitations of the present study are worth mentioning. With respect to the initial selection of patients, they likely represented a convenient sample rather than a random sample of the entire population. The control group did not get the same form of time-consuming intervention.

Conclusion
McKenzie extension exercise approach is a more effective treatment than conventional physical therapy for patients with chronic LBP with radiculopathy who demonstrating centralization with lumbar extension. In turn, these results could provide health care professionals with an appropriate intervention to manage LBP conservatively.

Conflicts of interest
All authors have no conflicts of interest to declare.

REFERENCES


