

The Effect of Extension Based Treatment Technique in McKenzie's Derangement Syndrome on Recruitment of Multifidus and Endurance of Back Extensor Muscles

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Abstract: *The McKenzie method is a good active therapy option that includes both exercises and education for the treatment of patients with CLBP. Methodology: 22 subjects with CLBP underwent McKenzie extension exercises for CLBP. Intervention program was carried out for 2 weeks, 8 sessions. Outcome measures evaluated were Rolland-Morris Low Back Pain and Disability Questionnaire, Modified Oswestry Low Back Pain Questionnaire, to test for endurance and recruitment of multifidus was assessed. Conclusions: Extension based treatment program in McKenzie's derangement syndrome improves the recruitment of multifidus on the affected side, improves the endurance of back extensor muscles and reduced disability.*

Keywords: Chronic low back pain, derangement syndrome, McKenzie extension exercises, multifidus, endurance

1. Introduction

Supervised exercise therapy associated with an educational component has been considered one of the most effective interventions in decreasing pain and disability in patients with chronic nonspecific low back pain.¹ The McKenzie method is a good active therapy option that includes both exercises and education for the treatment of patients with chronic low back pain.¹ A high proportion of patients who fit the derangement classification demonstrate a limitation of extension range, which improves when treatment procedures that cause a reduction, abolition, or centralization of symptoms are applied (McKenzie and May, 2003). Dysfunction in Multifidus muscles is strongly associated with LBP. The dysfunction is a result of pain inhibition from the spine, and it tends to continue even after the pain has resolved, likely contributing to the high recurrence rate of LBP. A deficiency of isometric lower back muscle endurance is supposed to be a major risk for non-specific low back pain.² Decreased endurance has been noted as a predictor of first-time occurrence of LBP, and also as a finding in persons with CLBP. Nowadays, the rehabilitation programs in patients who suffer from recurrent lumbar back pain include electromyographic (EMG) evaluation. EMG has proved a very important clinical research ally as a tool for evaluating functions and dysfunctions of the spine.³ Alessandra Narciso Garcia et al in their study found that, the McKenzie method (a more resource-intensive intervention) was slightly more effective than the Back School method for disability.¹ McKenzie exercises are successful method for decreasing and centralizing the pain and increasing spinal movements in patients with low back pain.¹

With this background and related evidence based literature, the aim of my study was to assess the effect of extension based treatment technique in McKenzie's Derangement syndrome on recruitment of multifidus and endurance of back extensor muscles.

2. Materials and Methodology

Study setting: Physiotherapy OPD No 27, Padmashree. Dr. D. Y. Patil Hospital and Research Centre, Nerul, Navi Mumbai.

Sample size: 22 subjects with chronic LBP (CLBP), Study duration: 1 year

2.1 Patient Selection Criteria

- Inclusion criteria:** Chronic non-specific mechanical LBP (duration of symptoms > 7 weeks)⁴, with or without radiation to the leg.
- Exclusion criteria:** Low back pain other than derangement syndrome
- Materials used:** McKenzie assessment form, SEMG machine, Roland-Morris Low Back Pain and Disability Questionnaire, Modified Oswestry Low Back Pain Questionnaire, Plinth, Small pillow, Stop watch, Marker, Ether, Adhesive Tape

2.2 Procedure

Approval for the study was gained from the Institutional Ethics Committee. All subjects were explained the Purpose of the study and written consent was taken from all of them prior to assessment. Patients meeting the inclusion criteria were selected for the study.

The patients with CLBP underwent a standardized McKenzie assessment and information was collected from the subjects regarding their gender, age, location and duration of symptoms, previous history of LBP, pain intensity and functional status. They were then classified as either, derangement or non-derangement, according to the operational definitions described by McKenzie and May (2003). In this study only derangement syndrome cases who had directional preference for extension were included. In

total 26 subjects with CLBP having posterior derangement syndrome were recruited. They were then given 8 sessions of extension treatment procedures during 2 weeks, 4 times a week.

The treatment procedures included the following: prone lying, prone lying in extension exercise, posture correction, extension in lying exercises, extension in lying with over-pressure, extension mobilization, extension in standing exercises, slouch overcorrect, self correction of lateral shift or side gliding and manual correction of lateral shift (McKenzie and May, 2003). All subjects were provided with a home program of extension exercises and advice. There were 4 dropouts during the treatment program. Hence for statistical tests only 22 subjects were considered.

The following were the outcome measures which were evaluated pre and post intervention:

The functional status of patients was checked with Rolland Morris Disability questionnaire and Modified Oswestry Low Back Pain Questionnaire.

The endurance of the patients was checked with the ITO test and

The recruitment of multifidus was checked with SEMG. Data thus collected was statistically analyzed for the level of significance.

2.3 SEMG machine

The PSIS were palpated and midpoint between them was marked. This corresponds to the S2 spinous process. The area is cleaned with ether and electrodes were placed on the surface of the multifidus muscles according to the SENIAM (Surface ElectroMyoGraphy for the Non-Invasive Assessment of Muscles) recommendations. The subject should be in prone position and slight trunk flexion. The electrodes should be placed aligned 2 or 3 cm from the midline of the L5 spinous process which can be palpated just above the S2 spinous process.^{3,5}

3. Results and Observations

Table 1: Comparison of PRE and POST VAS

VAS	Mean	SD	Upper 95% CI	Lower 95% CI	P Value
Pre	6.318	1.524	6.994	5.642	< 0.0001*
Post	1.773	1.232	2.319	1.227	

Table 2: Comparison between MF Extension PRE & POST at Channels A & B

MF Extension	Mean	SD	Upper 95% CI	Lower 95% CI	P Value
PRE ChA	48.59	31.56	62.58	34.59	0.7853 NS
POST ChA	49.80	31.56	63.74	35.86	
PRE ChB	55.83	40.43	73.76	37.91	0.6262 NS
POST ChB	51.36	28.58	64.03	38.68	

Table 3: Comparison between LPR PRE & POST at Channels A & B

LPR	Mean	SD	Upper 95% CI	Lower 95% CI	P Value
PRE ChA	37.09	34.54	52.4	21.77	0.8710 NS
POST ChA	39.19	35.92	55.11	23.26	

PRE ChB	33.07	25.1	45.48	20.65	0.2687 NS
POST ChB	28.01	13.27	30.98	19.22	

Table 4: Comparison between MVIC PRE & POST at Channels A & B

MVIC	Mean	SD	Upper 95% CI	Lower 95% CI	P Value
PRE ChA	48.74	27.33	60.86	36.62	0.0778 NS
POST ChA	60.00	34.38	75.25	44.76	
PRE ChB	49.39	32.72	63.90	34.89	0.5506 NS
POST ChB	53.93	27.93	66.31	41.54	

Table 5: Comparison of ITO test PRE and POST Scores

ITO	Mean	SD	Upper 95% CI	Lower 95% CI	P Value
Pre	52.82	26.17	64.42	41.21	< 0.0001*
Post	123	37.57	139.7	106.4	

Table 6: Comparison of Roland-Morris Low Back Pain and Disability Questionnaire PRE and POST scores

RM	Mean	SD	Upper 95% CI	Lower 95% CI	P Value
Pre	11.23	4.02	13.01	9.44	< 0.0001*
Post	3.364	1.94	4.224	2.503	

Table 7: Comparison of Modified Oswestry Disability Questionnaire PRE and POST Scores

MOQ	Mean	SD	Upper 95% CI	Lower 95% CI	P Value
Pre	26.45	9.716	30.76	22.15	< 0.0001*
Post	9.545	6.53	12.44	6.65	

4. Discussion

Disc herniation is the major cause of nerve root pain, most commonly experienced as sciatica. However, disc herniation does not necessarily produce symptoms. MRI scans reveal disc herniations in many asymptomatic volunteers: Boden et al. found at least one herniated disc in 20%.⁶ As a first step in developing rehabilitation strategies to enhance recovery from back injuries, it is necessary to carefully characterize changes in muscle function due to back pain. Muscle dysfunction is defined as an unusual pattern of muscle recruitment during prescribed set of movements.⁷

According to Table 1, reduction in pain was significant as measured by the VAS pre and post treatment. This improvement can be attributed to the directional preference and centralization phenomenon of McKenzie exercises for CLBP patients.

Directional preference has been defined as the repeated movement which induces centralization or abolition of symptoms, but also a decrease in symptom severity, and/or a positive mechanical response, such as an increase in range of movement (McKenzie and May, 2003).⁸ Movements in the opposite direction may cause these symptoms and signs to worsen. A finding of directional preference at baseline has been shown to predict a significantly better response to directional preference exercises than non-specific exercises (Long et al., 2004, 2008).

Centralization: In response to therapeutic loading strategies pain is progressively abolished in a distal to proximal

direction. Each progressive abolition is retained over time, until all symptoms are abolished, and if back pain only is present this moves from a widespread to a more central location and then is abolished OR pain is decreased and then abolished during the application of therapeutic loading strategies. The change in pain location, or decrease or abolition of pain remain better, and should be accompanied or preceded by improvements in the mechanical presentation (range of movement and/or deformity)⁹ Centralization and directional preference appear to be well accepted concepts commonly encountered by clinicians examining patients with back pain, of a specific or non-specific nature. Centralization is generally associated with a good prognosis. There is evidence for directional preference as a treatment effect modifier.¹⁰

According to Table 2 and 4, there was imbalance in recruitment of MF between affected and non-affected side before treatment which was corrected, leading to which there was symmetrical firing of MF after treatment. Asymmetrical muscle activation could possibly be of clinical significance. Spinal posture has a marked effect on stresses within the disc and neural arch, and on the dimensions of the intervertebral foramen. Therefore, it is conceivable that back pain could arise from gross left-right asymmetries in the back muscles, or from an imbalance in flexor/extensor muscle strength, if the asymmetry was sufficiently marked to change the angulation of adjacent lumbar vertebrae by 2 degrees or more. Large asymmetries have been detected in the electromyographic signals from the back muscles of patients with back pain. Asymmetrical muscle activation may represent an attempt by muscles on one side of the back to 'splint' a painful spinal segment, or they may occur as a result of selective muscle atrophy, or following reflex inhibition.

Macintosh et al described the morphology of the LMM by means of the dissection of 12 adult cadaver spines and postulated that from an anatomic perspective, the shared innervation of the zygapophyseal joints means that pain emanating from these joints could result in a reflex inhibition of the LMM at the same level.¹¹ The diminished ability to recruit the MF is due to smaller cross-sectional area of MF in CLBP patients. Alternatively, the muscular changes may be a consequence of pain and possible long-loop inhibition of the MF, whereby a combination of reflex inhibition and substitution patterns of the trunk muscles might result in selective atrophy of MF.⁶ So as the recruitment of multifidus improves, the MVIC of the affected side also increases. Therefore even though the results are statistically not significant, it is of clinical significance to us.

According to Table 3, which compares pre & post lumbo pelvic rhythm at affected and non-affected sides, there is improvement in recruitment of MF on the affected side during LPR post our intervention program. Rapid forward bending movements of the spine cause the back muscles to contract vigorously in order to decelerate the upper body and prevent hyper flexion injury. This back muscle activation may be at least partly reflex in nature.⁶ Any loss of stretch reflexes will reduce the ability of back muscles to protect the lumbar spine by contracting vigorously as the limit of

flexion is approached. This protective action has been demonstrated when subjects bend forwards to lift an object from the ground: a sudden burst of back muscle activity decelerates the upper body, and prevents excessive lumbar flexion. This clearly explains why non-affected side MF recruitment reduced and affected side MF recruitment increased after our treatment program.

Spinal reflexes may have direct links with back pain. Chronic joint pain and swelling are known to inhibit the recruitment of specific muscles near the joint via a 'short loop' spinal reflex. Inhibition of specific back muscles may also arise from a 'long loop' reflex, involving perceived pain, and generalized muscle disuse atrophy can result from any chronic pain. Control of the lumbar neutral zone was an important component of LBP and disability prevention.^{12,13} A failure of spinal reflexes could explain why people tend to apply much higher bending moments to their lumbar spine when bending forwards during the early morning compared to later in the day.

Improvement in the endurance of back extensors were seen post intervention program using the Ito test which was statistically extremely significant. Decreased endurance has been noted as a predictor of first-time occurrence of LBP, and also as a finding in persons with CLBP. Training has been shown to improve measured endurance characteristics of the trunk muscles.¹⁴ This is also supported by our study as seen in Graph & Table 5. Hence our study proves that as pain and disability reduces with McKenzie intervention, the endurance of back extensors also increases.

Patients with sciatica who centralized at baseline had significant improvements in pain and disability both short term and long term¹⁵ According to Table 6 and 7, reduction in the functional disability was significant as measured by Rolland-Morris Disability Questionnaire and Modified Oswestry Low Back Pain Questionnaire pre and post McKenzie intervention program. The presence of centralization also had an impact on chronic pain and disability (Edmond et al., 2010).

Thus our research strengthens the evidence that McKenzie's extension exercise program decreases pain and disability in CLBP patients with posterior derangement syndrome, influencing MF recruitment, thus, normalizing the balance of MF firing between the affected and non-affected side leading to increase in the endurance of back extensor muscles.

5. Conclusions

Effect of extension based treatment program in McKenzie's derangement syndrome improves the recruitment of multifidus on the affected side. Effect of extension based treatment program in McKenzie's derangement syndrome improves the endurance of back extensor muscles. Effect of extension based treatment program in McKenzie's derangement syndrome was found to be functionally beneficial.

6. Clinical Implications

McKenzie's extension based exercise needs to be prescribed in patients with CLBP having posterior derangement syndrome. Back extensor endurance needs to be assessed with Ito test as a routine assessment in patients with CLBP having posterior derangement syndrome. Recruitment of multifidus with SEMG can routinely be done to assess the impact of CLBP and its management.

7. Further Scope of the Study

Extension range can be taken into consideration as an outcome measure. Patients with non-centralization can be identified using McKenzie evaluation proforma and their psychosocial components can be treated with cognitive behavioral therapy. During Ito test, SEMG of multifidus can be done.

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