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Patients with Low Back Pain Benefit from Core Stability and Motor Control Exercises

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Abstract

Motor control exercises improve the deep spinal muscles (transverse abdominus, multifidus), whereas core stability involves global core muscle training. Few studies have examined the short-term effects of motor control and core stability on low back pain patients. This research compared motor control exercises to core stability exercises on pain and impairment in people with mechanical low back pain. 30 participants with non-specific mechanical low back pain were randomised into 2 groups of 15 each. Group A did motor control exercises, while Group B did core stability. Both groups did activities. Statistically significant improvement (p0.05) in pain and functional impairment was discovered using paired t-test and wilcoxon signed rank test. Comparative investigation utilising independent t-test and Mann Whitney U test indicated significant difference in VAS and ODI improvement across groups. Group-A improved VAS and ODI by 1.47 and 0.99 compared to Group B.

Keywords: Back pain, core stability, exercises.

Introduction

A mechanical low back pain is a musculoskeletal discomfort that fluctuates with physical activity and does not include root compression or significant spinal illnesses. This type of pain is most commonly experienced

in the lower back. In most situations, the pain is localised to one side of the body and does not radiate below the knee. This type of pain can be caused by trauma to the muscles or ligaments, the facet joint, or in rare instances, the sacroiliac joint.¹ It is estimated that as much as 90 percent of the world's population will suffer from lower back discomfort at some point in their lives. About one-third of the population in India is affected by persistent back pain, which greatly impairs their ability to go about their daily lives.^{2,3} Not only is the efficient care of this illness essential for the alleviation of symptoms, but it is also essential for the avoidance of recurring episodes of back pain, personal suffering, and lost job productivity. Patients who suffer from persistent low back pain have

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been shown in a number of studies to have reduced levels of both the strength and endurance capacities of their back muscles. There has been a disturbance in the regulation of the deep trunk muscles (such as transversus abdominis and multifidus), which are important for the stability of the spine, according to four studies that were conducted on people who suffered from low back pain.³ Patients who suffer from back pain can be treated using a number of different approaches. Although there is evidence that conventional therapy can be useful in the short term for the alleviation of pain and restoration of mobility, this therapy has not been successful in meeting the challenge of reducing persistent and repeated bouts of back pain. This was also our experience in the clinic, and in addition, it seemed that general back exercises had the same restrictions as pain control as well as the objective of preventing recurring or chronic bouts of pain.⁵ The idea that people who suffer from low back pain have poor control of their trunk muscles inspired the development of a new type of exercise called motor control exercise. The concept of employing a learning strategy that focuses on motor control in order to retrain the optimum control and coordination of the spine. Preactivation of the deep trunk muscles is the first step in the intervention, which is followed by more difficult static, dynamic, and functional tasks that integrate activation of deep and global trunk muscles.^{3,6} In recent years, core strengthening has emerged as a prominent trend in the field of rehabilitation. The term “core strengthening” refers to the development of the muscle control around the lumbar spine that is essential for the maintenance of functional stability.⁶ It is a preventative regimen that may also be used as a kind of rehabilitation and as a performance-enhancing programme for a variety of ailments affecting the lumbar spine and the musculoskeletal system.³ The principle of core stability has gained widespread acceptance in the training industry for the purpose of injury prevention as well as the treatment of a variety of musculoskeletal problems.⁷ The workouts for motor control focus on isolated strengthening. Activities that target the deeper muscles of the spine (transverse abdominis, multifidus).⁷ Global strengthening is the means through which fundamental stability can be attained.⁸⁻¹⁰ There are not a lot of research that have been done or evaluated the short term effect of the motor control and core stabilisation on patients who have low back pain. These studies are not available in the literature. The results of this research aid in the planning and treatment of low back pain, which, if

left untreated, can become a chronic condition and may have an influence on a person’s ability to participate in social activities.^{3,4} As a result, the goal of this study is to compare the effects of core stability exercises and motor control exercises on the participants who have mechanical low back pain in order to see whether type of exercises is more effective in reducing pain and impairment. It was expected that there would not be a significant difference in the capacity of core stability exercise and motor control exercise to reduce pain and impairment in individuals who suffer from mechanical low back pain. This hypothesis was tested and shown to be false.

Core Stability

Many authors have attempted to define core stability, which consequently means a globally accepted definition is yet to be confirmed. However, a widely accepted definition of core stability is:

“Comprises of the lumbopelvic-hip complex and is the capacity to maintain the equilibrium of the vertebral column within its physiologic limits by reducing displacement from perturbations and maintaining structural integrity,” according to Medical News Today. “Maintaining the equilibrium of the vertebral column”

Henry and Florence Kendall, who were both physiotherapists who initially created the concept of a “neutral pelvis” in the 1940s and 1950s, are credited with being the first people to acknowledge the need of core stability.

In the beginning, they hypothesised that the surrounding superficial muscle groups were accountable for the alignment and “neutral spine” maintenance. The erector spinae, hamstrings, abdominals, and hip flexors were the muscles that they were referring to when they made this statement. As a direct consequence of this finding, it was hypothesised that pelvic tilt was a movement of the pelvis that deviated from its neutral position.

The idea of core stability has evolved over the years, and recent works by writers such as Paul Hodges have brought to light the relevance of the Transversus Abdominis muscle and the role it plays in maintaining core stability, in particular lumbopelvic stability. On this basis, it has now become an important part of the management of spinal stability, and exercises oriented upon the activation, recruitment, and strengthening of the core are a common

avenue of treatment. This is due to the fact that the core is responsible for the majority of the body's movement.

Theories and Applications

Panjabi developed a categorization model that supplied an explanation into the working of the spine as a way to bring some clarity to the phenomenon of the stabilising system of the spine. This was done in an attempt to add some clarity to the situation. His model included the three subcategories "Active," "Passive," and "Neural," and it is clear that he placed a significant emphasis on the necessity of core stability.

Passive: The passive category consists of the basic components of the spine which allow for soft tissue attachment.

- The lumbar vertebrae
- The joint capsules
- The intervertebral disc
- Ligaments surrounding the area

When the spine is in its neutral posture, these spinal structures do not provide any substantial contributions to the stability of the spine. However, the skeletal structure does support the basic framework, and the tensile properties present in the various ligaments do start to resist end range movement. However, the skeletal structure does not have the capability to produce forces that initiate spinal movement because this movement is not caused by the passive structures.

Active: In addition to giving a contribution to the segmentation of the spinal column, the active structures are also responsible for the commencement of large-scale spinal movement.

Bergmark (1989) added an additional classification to the active system by dividing the stabilising system into a local and global system. It was anticipated that the local globalising system would play a major role in the upkeep of spinal segment stability and stiffness. It was mentioned that the global stabilising system is more superficial, and its major job is to provide force in order to regulate movement. Additionally, it was mentioned that there are often eccentric contractions in order to control motion segments across the range.

Global Mobilisers: Comerford and Mottram (2001) offered an additional active functional classification. They came up with the concept of "global mobilisers," which is a further active functional classification. The fundamental purpose of these muscles is to absorb stress and to produce the large spinal concentric contractions that are necessary for gross motor function. They also play a role in maintaining proper posture.

Neural: According to Punjabi, it is the responsibility of the neural component to receive information from the numerous transducers and then pass that information, together with the relative signal, onto the active system in order to establish segmental stability. The brain components will continue to manage the active systems until there has been sufficient progress made toward achieving stability.

Methodology

A design for a comparative experimental research with two groups, Group A performing exercises to improve motor control, and Group B performing exercises to improve core stability. In light of the fact that this research involved human participants, the Oxford College of Physiotherapy in Bangalore's Ethical Committee was contacted in order to receive ethical clearance. This was done in accordance with the ethical guidelines that govern the conduct of biomedical research on human subjects. Subjects were considered for inclusion in the study if they had been diagnosed with non-specific mechanical low back pain, were between the ages of 30 and 45, were either male or female, had a minimum to moderate disability (up to 40%) according to the Oswestry Disability Questionnaire, had a VAS score of less than 5 cm, and were willing to take part in the research. Subjects who had any prior or present expertise in core strengthening were not allowed to participate in the study. Those that are participating in a consistent exercise routine, a history of bone breaks (such as in the spine or ribs) or injuries, a history of abdominal surgery in the past, any other condition affecting the system, diseases affecting the spine or the discs. The Indira College Physiotherapy Outpatient Department (OPD) and The Yashosai Hospital in Nanded, were both used to source participants. The Indira College Physiotherapy OPD in Nanded served as the location for the research project. Subjects who satisfied the inclusion criteria were recruited by a simple random sample procedure utilising the lottery method. Subjects were then randomly assigned

to one of two groups. In order to maintain objectivity and guarantee that all of the requirements were met, we kept the subjects in the dark about their group assignments. All thirty subjects (n=30) who satisfied the inclusion criteria were briefed about the study, with fifteen participants assigned to each group. A written informed permission was obtained from each participant. Within the context of the trial, the intervention lasted for a total of two weeks.

Procedure of Intervention for Group A: Subjects in this group received motor control exercises with conventional exercises under supervision.

Stage-I-First Week: 8 reps: workouts for the multifidus and transverse abdominus were complemented with exercises for the pelvic floor muscles, respiratory control, and regulation of spinal posture. the exercises involve retraining the multifidus and transverse abdominus.

1. Isolation of Transversus Abdominis and training:

Step 1: The subject was lying supine with their spine in a neutral posture (gentle anterior curve in the lumbar spine). The patient received assistance in pressing their lumbar back to the ground, which created a posterior tilt at the pelvis. The patient was instructed to place their hands on the ASIS, elevate their scapula till the inferior angle, and simultaneously breathe in and out while contracting their transversus abdominis muscle. Move with each breath; push yourself while you exhale, and pause or hold while you breathe in.

Step 2: In order to strengthen the co-activated core, the patient was first instructed on how to isolate the transverse abdominis muscle, and then they were shown how to execute isolation and activation exercises while in a variety of situations, such as sitting, standing, and bending over. After some time had passed, the workouts were then gradually advanced to the following exercises: a. When the patient is lying on their side, the patient should keep their ankles together and lift their top knee, then their ankle, then extend their leg, then flex their leg, then return their ankle, and finally their knee; b. When the patient is lying on their back with their knees and hips flexed, the patient should be instructed to lift their right foot off the floor, and then their left foot off the floor. Leg extensions in alternating order, with attention paid to maintaining an appropriate technique for core stability. Exert yourself by breathing out, and when you need to relax or pause, breathe in.

2. Isolation of Multifidus and training: Patient is positioned in the side-lying position with a neutral spine posture. Flexion is done at the hips. The therapist applies pressure on the multifidus in order to (find the spinous process and then fall off into the gutter just sideways from the bone). In comparison to the other side, the hole or soft region that results from a lack of multifidus can be uncomfortable. Instructions:

Step 1: The patient was advised to visualise a guy wire extending from the innermost portion of the legs, up through the groin, through the pelvis, and ending at the finger that was palpating the multifidus. Request that the patient breathe in, then instruct them to contract their multifidus muscle with the picture or link their leg firmly along the guy wire as they exhale (think about drawing the thigh into the pelvis). The patient was given the instruction to imagine that they were hanging, or raising, the vertebra slightly off the one below it (like lifting the lid of a tea pot). There should be no real movement of the hip, pelvis, or spine at any point throughout the procedure. The contraction of the multifidus should feel like a gradual, firm 'swelling' under the therapist's finger, similar to the way air fills up a balloon. The therapist should not sense a quick contraction during this process. Maintain the contraction without being too rigid, and make sure you keep breathing throughout. entails making the exercise more difficult by working through a series of different functional tasks and exercises that focus on the synchronisation of movement between the trunk and the limbs as well as the preservation of the stable position of the trunk.

Step 2: The patient should be able to practise isolating the multifidus and the transversus abdominis muscle in a variety of positions, such as sitting, standing, bending over, and so on. Once the patient has achieved this goal, the co-activated core should be strengthened. Once the patient is able to readily activate the muscle, they should continue to the subsequent exercise. Each progression listed below begins with a healthy core contraction (which includes the pelvic floor), and this connection should be maintained throughout the movement. Always keep in mind that you should move with a controlled breathing rhythm, meaning that you should exert while exhaling, breathe into rest, or hold. Patient position: While resting on your side, maintain your connection to the multifidus muscle by

keeping your ankles together. Raise your upper knee, followed by your ankle; next, extend your leg; lastly, flex your leg; then return your ankle, and then your knee.

Stage-II: Second Week: Motor Control Exercise- 15reps with 5-10 sec hold

Step 3: Incorporate into other activities: The final step is to remember to use the core during regular life activities.

Isolation of Pelvic Floor: The patient should either sit or lie down in a position that does not put any pressure on the spine. Request that the patient give you a hard abdominal palpation. The patient was given the instruction to think about the muscles that surround their urethra and vagina as well as the muscles that bring their testicles up, and then they were told to softly and slowly raise their urethra, vagina, or testicles up and forward into their belly. Also, the muscles around the anus, and you should consider contracting them (same movements was instructed to do after completing a bowel movement).

Procedure of Intervention for Group B: Exercises focusing on core stability were performed on the subjects in this group using conventional exercises.

Stage-I: First Week: 8 reps

1. **Transversus Abdominus (Ta) Activation:** The patient is in the supine position and is instructed to position his or her fingers two centimetres in and down from the ASIS. Requested a drawing of the patient's pelvic floor from the patient. Additionally, pull the stomach in toward the spine, and hold this contraction for ten seconds.
2. **Transversus Abdominus Marching:** Patient is instructed to lie supine and pull the pelvic floor and belly button in toward the patient. Instruct the patient to keep the muscular contraction going while simultaneously lifting one leg off the ground, holding this position, and then returning to the beginning position. Alternate legs.
3. **Pelvic Tilt:** Patient in supine lying. Ask the patient to slowly tilt the pelvis into anterior and posterior.
4. **Segmental Bridge:** The patient is positioned supine with their feet hip-distance apart from each other. Ask the subject or the patient to tilt their pelvis while you

slowly move their pelvis off the mat. Assist the patient if necessary. Request that the patient move each each vertebra in turn.

Stage-II: Second Week: 15reps with 5-10 sec hold

5. **Fall Out:** Patient is positioned in the supine position, with their feet and knees together. Give the patient instructions on how to pull in their pelvic floor as well as their belly button. Now, ask the patient for their assistance or ask them to slowly move their knees three centimetres to the side while maintaining their torso steady. Come back to the centre, and then repeat the process on the opposite side.
6. **Modified Crunch:** Patient lying on their back with the hands by their ears. Instruction: lift up the head and shoulder off the mat.
7. **Cat Stretch:** Starting position: 4 point kneeling position maintain the neutral spine posture. Instruction: make a hump at the spine.
8. **Back Extension:** The patient should be lying on their stomach with their hands in a position that is parallel to their ears. Instructions: Tell the patient to elevate their head and shoulders off the mat. Keep in mind that you should only lift one vertebra at a time.

Exercise for Back Extension:

Cool down exercise 5-10 minutes: At the end of each day's workout session, the participants were given a series of stretches to perform, followed by activities designed to calm down their muscles. Before beginning the training for the following session, the participants were questioned once more about whether or not they were experiencing any pain. Post-test scores were evaluated for both groups after a motor control exercise and core stabilisation exercise programme had been completed for a total of two weeks. The same assessment techniques were used for both groups. Both groups worked out under the physiotherapist's watchful eye as they carried out the exercises prescribed for them.

Exercise Protocol

Treatment Duration: 60 minutes: It consists of a warm-up exercise session that lasts between 5 and 10 minutes, a cool-down exercise session that lasts between 5 and 10 minutes, and an exercise training session that lasts between 30 and 40 minutes, with 2 minutes of rest time in between sets. It is possible for the period of treatment to

differ between the participants in Group A and Group B, as well as depending on the performance of the individuals.

Total duration: 2 Weeks: The number of sessions is five sessions per week, with one session occurring each day. 1st week: 8 reps 15 repetitions with a 5-10 second hold for the second week

Common Warm up Exercises protocol for both the Groups 5-10 mins: It included running in place for a set amount of time before moving on to a series of free movements, an exercise that focused on diaphragmatic breathing, and some mild stretches that were held for a minute and a half each. On the basis of an evaluation (the results of which may vary depending on the participants), such as the hamstring, hip flexor, and low back muscles.

Outcome measures: The individuals had their pretreatment scores obtained, which comprised an evaluation of their level of pain using a visual analogue scale (VAS), as well as an assessment of their level of functional handicap using the Oswestry disability index. Following the conclusion of the treatment phase, which lasted for a total of two weeks, post treatment scores were obtained in order to determine the degree of change that occurred between the pre and post treatment scores.

VAS: Pain was measured with the visual analog scale where subjects were asked to indicate on the scale, the severity of pain from the range of 0 (zero) no pain to 10(ten) most severe pain was measured.

Oswestry Disability Index: The Oswestry disability index is comprised of ten questions, each of which is followed by a set of six possible answers. These questions are primarily concerned with the degree of pain, personal care, lifting, walking, sitting, standing, sleeping, social life, travelling, and employment or homemaking. After assigning a point value between 0 and 5 to each inquiry, the total number of points received is then converted into a percentage. 16 It would appear that the Oswestry index is able to identify the degree of functional impairment exhibited by a patient suffering from a variety of spine illnesses. The Oswestry Disability Index has been shown to have a high level of reliability in test-retest performance both clinically at the time of the original evaluation and up to six weeks after the completion of any therapies.

However, two research suggest that the Oswestry has a response rate of 0.94. Questionnaires have responsiveness rates ranging from 0.76-0.78, however both studies focus on the Oswestry.

Results

The research was successful with a total of 30 participants (Table-1). In Group A, there were 15 participants, with a mean age of 37 years, 10 men and 5 females were involved in the study. The ages of the subjects ranged from 18 to 45. There were 15 participants in the research who were assigned to Group B. The individuals' average age was 37.07 years, and there were 9 males and 6 females in the group. The average ages of the two groups are not significantly different from one another.

The comparison of pre-treatment and post-treatment values on the VAS for the two groups (Table-2 and Graph-). This demonstrates that there was a statistically significant improvement between the before and post mean scores for both of the groups. When the pre and post mean scores for Group A (Motor control Exercise) were compared, there was substantial improvement from 3.80.83 to 2.730.85 with a p value of less than 0.01, while in Group B there was significant improvement from 3.731.06 to 3.21.06 with a p value less than 0.01, respectively. The comparison of the ODI scores before and after the event for the two groups (Table-3 and Graph-2). There was a statistically significant improvement between the pre and post mean scores for both of the groups. After 2 weeks of intervention, there was a significant improvement in both Group A and Group B when the pre and post mean scores were compared. In Group A, there was a significant improvement from 18.86.56 to 16.534.76 with $p < 0.01^*$, and in Group B, there was a significant improvement from 25.877.64 to 24.87.64 with $p < 0.01^*$.

When comparing the differences in improvement in VAS and ODI between the two groups, it was discovered that there was a substantial difference in improvement of VAS and ODI between groups (Table-4 and Graph-3). When compared to Group B, the VAS and ODI scores for Group A demonstrated a greater degree of improvement, with an effect size of 1.47 and 0.99, respectively.

Table 1: Fundamental attributes of the topics that have been researched

Basic Characteristics of the subjects studied		Group A		Group B		Between the groups Significance
Total number of subjects studied (n)		15		15		--
Age in years (Mean± SD)		37.07±2.76 (35-45)		37.07±3.51 (42-30)		P<0.05
Gender	Males	n=10	66.7%	n=9	60.0%	p= 0.705 (NS)
	Females	n=5	33.3%	n=6	40.0%	

Table 2: Evaluation of participants' pre- and post-treatment VAS ratings within groups

VAS	Group A	Group B
Pre-Intervention Mean ± SD (Min-Max)	3.8±0.83 (2-5)	3.73±1.06 (2-5)
Post-Intervention Mean ± SD (Min-Max)	2.73±0.85 (2-4)	3.2±1.06 (2-4)
P value	0.01*	0.01*
Z score	2.14	1.80
Effect size	1.27	0.5

*Statistically Significant difference p<0.05; NS- Not significant

Table 3: Comparison of pre and post scores of ODI Index within two groups

ODI	Group A	Group B
Pre-Intervention Mean ± SD (Min-Max)	18.8±6.56 (6-32)	25.87±7.64 (14-40)
Post-Intervention Mean ± SD (Min-Max)	16.53±4.76 (8-26)	24.8±7.64 (14-38)
P value	<0.01*	<0.01*
Z score	2.32	2.32
Effect size	1.3	0.9

*Statistically Significant difference p<0.05; NS- Not significant

Table 4: A comparison of the various groups' respective levels of improvement on the VAS and ODI

Study parameters	Group A(Mean)	Group B (Mean)	p value	Effect size
VAS	1.07± 0.02	0.53 ± 0.52	<0.01*	1.47
ODI	2.27 ± 1.8	1.07 ± 0.99	<0.01*	0.99

*Statistically Significant difference p<0.05; NS- Not significant

Conclusion

When compared to the Core Stabilization exercises, the Motor Control exercises demonstrated a statistically significant improvement in lowering the amount of back discomfort and impairment experienced by the participants. In conclusion, among people who suffer from nonspecific mechanical low back ache, engaging in Motor Control exercises results in a substantial reduction in pain and impairment as compared to Core stabilisation activities.

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