



Review Article

REVIEWING THE ROLE OF SPECIFIC CORE STABILITY EXERCISES IN THE MANAGEMENT OF CHRONIC LOW BACK PAIN

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ABSTRACT

In the Western world low back pain is a major cause of disability and about 60-70% life time prevalence rate has been reported. The financial consequences of this problem are enormous. Electronic data bases were searched for this review. It seems difficult to identify the underlying cause of chronic low back pain. Different theories explained the relationship between lumbar instability and chronic low back pain and Punjabi's theory is widely accepted. Some evidence suggests relationship between lumbar stability muscles and chronic low back pain but no direct relation could be identified. It appeared that the transversus abdominus, multifidus and erector spinae are the key lumbar stabilisers and their role has been proven in research. The literature compares core stability exercise with general strengthening exercises, manual therapy and evaluates core stability exercises alone. According to the available evidence both specific core stability exercises and general strengthening exercises are effective in the management of chronic low back pain. Core stability exercise appeared superior to manual therapy but there is still a need to carry out further good quality RCT trials. Core stability found to be effective in a cohort and single case study designs. Overall it seems that core stability exercises have a place in chronic low back pain due to lumbar stability. Further research is required to identify which subgroup of chronic low back patients would respond best to core stability exercise or other physiotherapy treatment options.

Key words: "Chronic Low Back Pain", "Core Stability Exercises", "Rehabilitation", and "Physiotherapy"

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INTRODUCTION:

Low back pain is one of a common problem in adult's especially working class. The medical cost of low back pain is considerably huge and it has been suggested that expenditure of low back pain in the NHS were estimated to be between £265 millions to £383 millions in the United Kingdom.^{1,2} The Department of Health survey suggested that 40% of adult complained of low back pain for the period of last 12 months. This survey further revealed that 15% of low back pain patients reported that they were in pain throughout the year and is about 40% of low back pain patients visited to their GP for help and nearly 10% went to see other health care providers such as osteopaths and acupuncturists. Similarly in the American adults 35% to 40% one-year prevalence rate was reported with lifetime prevalence rate of 60% to 80%.^{3,4} There are three types of low back pain: acute (6 weeks or shorter), sub acute (6 to 12 weeks) and chronic in nature (longer than 12 weeks). Range of signs and symptoms could be arise following low back pain such as pain, muscle spasm or tightness, and could be localised around the area of the shoulder blade and in the region of buttocks with or without spreading pain to the legs.⁵

A huge amount debate and research around the world has been taking place regarding

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the best treatment options for low back pain. In the literature there are many treatment options for low back pain (see table 1). From the above treatment options lumbar instability concept is very popular amongst health care providers in the Western Europe, Australia and New Zealand. This concept has been studied by clinicians for over a decade and yet, and despite considerable research, relatively little is known of clear role of lumbar stability muscles in low back pain rehabilitation, and some controversy still persists regarding its significant role for low back pain management in the scientific literatures.

METHODOLOGY:

A literature review has been conducted to explore the essay title by searching electronic based resources such as Pubmed, Bionet, Cochrane Library, Medline, Science Direct, British Medical Journals, CINAHL and Google. Key words used were Lumbar instability, Lumbar disc, chronic low back pain, lumbago, sciatica core stability exercises”, “rehabilitation”, and “physiotherapy” with Boolean operator AND/OR/NOT. See table 2.

Furthermore selected article references lists were searched and reviewed since 1990. The literature highlighted comparing the role of specific core stabilisation exercises with other physiotherapy treatment options (general strengthening exercises and manipulative therapy), GP consultation, spinal fusion and lumbar stabilisation exercises alone in treating chronic low back pain. This review will focus on comparing specific core stability exercises with other physiotherapy options and evaluate specific core stability exercises alone in the management of chronic low back pain. This was chosen because sufficient data is not available to focus on individual issue and most studies compared core stability exercises

with different physiotherapy options. To review up to date literature, articles published prior to 1990, pilot studies and abstracts based information were excluded. In this review core stability has been used to connote lumbar stabilisation and motor control training. “Abdominal drawing” in various positions is a widely adapted exercise to teach co-contraction of transverse abdominis, multifidus and other lumbar stabilisers. Core stability is a description of the muscular control required around the lumbar spine to maintain functional stability.^{6,7,8}

Other physiotherapy options consisted of general strengthening exercises (leg lifting and body lifting in prone position, pull to the neck, bridging, lying to sit, abdominal crunches and abdominal muscle activation with Swiss ball. Studies included in this review used different outcome measures such as SEMG, short-form McGill pain questionnaire, Ronald-Moris disability questionnaire, pain self efficacy questionnaire, Tampa scale of kinesiphobia, pain locus of control scale, VAS, therapeutic associated outcomes system (TOAS). It is beyond the scope to discuss validity, reliability and responsiveness of these tools.

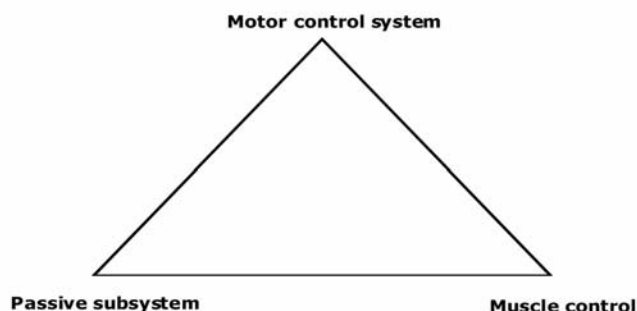
LUMBAR INSTABILITY AND LUMBAR STABILITY MUSCLES:

Lumbar instability has been mentioned as a source of CLBP in the absence of any skeletal defect but it is impossible to measure LI and there is no standard definition.⁹ In a study conducted by Punjabi et al. developed a widely accepted model of LI, According to this model instability occurs when there is an increase in the intervertebral neutral zone. This zone depends upon interaction of passive subsystem (osseous ligamentous) and active subsystem (muscle restraint).^{10,11} The motor control system coordinates with

**TABLE 1:
TREATMENT OPTIONS FOR CHRONIC LOW BACK PAIN (CLBP)**

COMMON TREATMENT OPTIONS FOR CLBP
● Acupuncture
● Back schools program
● Biofeedback EMG
● Facet joints injections
● Transcutaneous Electrical Nerve Stimulation
● Lumbar traction
● Spinal manipulations
● Exercise therapy
● Bed rest
● NSAIDS
● Muscle relaxants
● Analgesics
● Steroids injections (epidural) ⁶

**FIGURE 1:
INTERACTION OF PASSIVE SYSTEMS FOR CORE STABILITY.**



**TABLE 2:
KEY WORDS USED IN ELECTRONIC DATABASE SEARCH.**

Key Word	Boolean Operator	Key Word	Boolean Operator	Key Word
Lumbar instability Lumbar Disc	AND/OR/NOT	Chronic Low back pain Lumbago Sciatica	AND/OR/NOT	Core stability exercises Rehabilitation Physiotherapy

these two subsystems to meet the demands of stability (See figure 1).

One of the important components of the neutral zone is muscle control and weakness of the muscles causes an increase in neutral zone sensitivity. Stability is controlled directly by the muscles or through neural control.^{10,11} In Another study by Bergmark, classify muscles into local and global stabilisers but this concept was challenged by McGill and stated that all muscles maintain lumbar stability and their role varies according to activity.^{5,12} Similarly, in another study McGill and fellow introduced the theory of spinal buckling. They stated that spinal buckling could occur if muscle activation pattern is faulty or if their contraction is low. In chronic low back pain motor control is dysfunctional in stability muscles and proprioception has been reported to be impaired.^{13,14} However, it is beyond the scope of this work to discuss these factors in detail.

It appears from the research papers that the abdominal muscles, multifidus, erector spinae are the key muscles to provide the stability of lumbar spine.^{15,16} The general functions of these muscles have been widely focused by physiotherapists for low back pain rehabilitation.¹⁷ In abdominal muscles group, the role of transversus abdominis seems to be important in treating low back pain.^{18,19,20} Literature also suggested that Multifidus muscle plays key part in providing lumbar stability.^{21,22,23} A study concluded that the co-activation type of function of abdominal muscles with multifidus muscles maintain stiffness of lumbar spine, leading to provide dynamic stability of the lumbar spine.²⁴ Most research papers included in this work focused on the role of transversus abdominis, multifidus and erector spinae in treating chronic low back pain.

CORE STABILITY EXERCISES AND CHRONIC LOW BACK PAIN:

A number of patients with chronic low back pain have weakness in lumbar stability muscles therefore this is clinically relevant to conduct these types of studies. A study conducted to find the abdominal muscle recruitment pattern between synergists with regard to abdominal drawing manoeuvre using biofeedback monitor with patients having chronic low back pain. In this small (n=22) subjects study the control group (n=10) and chronic low back pain (n=12) received aerobic activity 3 times a week. Then subjects performed abdominal drawing manoeuvre to measure muscles activities of rectus abdominis and internal oblique by surface electromyography (SEMG). They found that the control group was able to activate internal oblique without significant rectus abdominis activation as compared to subjects with chronic low back pain. The authors further argued that the understanding of abdominal muscles activation and its dysfunction seems to be crucial in treating low back pain. On critical inspection of this paper, the authors did not use any functional or validated outcome measures following intervention of exercise regime.¹⁵ The surface electromyography is one of the common techniques for understanding of muscle function.^{25,26} It is important to note that the SEMG has limitations such as noise level, room temperature, skin hairs, skin thickness, muscle types, electrodes size and gender.^{27,28} The control of as many as the above factors seems to be important to prevent of any misinterpretation of EMG signal analysis. The above authors did not reveal that whether the above factor was considered during testing protocol, as they mentioned only about noise level. More importantly many of deep muscles are difficult to reach with surface EMG therefore may not provide full picture of important

deep muscles activity. In future studies inclusion of ultrasound imaging as an outcome measure may provide better picture of muscle activity. Ultrasound m-mode image at high time resolution can detect onset of muscle activity comparable accurate to intramuscular electromyography.²⁴

In another study, author used various subjective outcome measures and published a research paper to determine the impact of core stabilisation exercises with general strengthening exercises versus general strengthening exercises only with chronic low back pain. In this (n= 55) subjects RCT group one (n=29) subjects received core stability exercises plus general strengthening exercises in various postural positions. The intervention group two only received general trunk strengthening exercises in various postural positions. In this study, the authors used the Short- form McGill Pain questionnaire, Roland-Morris Disability questionnaire, Pain Self Efficacy questionnaire, Tampa Scale of kinesiophobia and Pain Locus of control scale as outcome measures. They noticed some improvement in disability on self- reported questionnaire just after intervention (8 weeks) in the group two but no improvements after 3 months follow-up. The authors concluded that general exercises group two demonstrated reduce disability in the short term as compared to group one. They further suggested that stabilisation of trunk muscles seems to provide additional benefit with low back pain in sub acute or chronic stages.²⁹ There are several points arises on critical appraisal of this study. Firstly, the authors compared trunk stabilisation training plus general strengthening exercises with general strengthening exercises only, instead of comparing between core stabilisation exercises with trunk general strengthening exercise to determine the impact on low back pain more clearly. Secondly, they used all self-reported subjective types of outcome measures and it would be nice if used any functional outcome measure conducted on baseline and at the end of study. Although questionnaires have a role further research needs to be done with functional measures to see whether subjectively reported improvements would lead to improvements in functional activities. To assess the activity of deep muscles they only relied on the physiotherapist although other measures like EMG and ultrasound scanner would give better results.³⁰ The follow up period was 3 months and data was collected only few times (at week 8 and 3 months) and it will be interesting to see whether these interventions would have any benefit over longer period.

In a RCT by Dannells and fellows in evaluated the effect of three different interventions on the cross sectional area of paravertebral muscles.³¹ This type of study is clinically relevant because atrophy of multifidus muscle is obvious after lumbar injury and about 80% of patients who have chronic back pain may have atrophy of this muscles.^{32,33} In this study group 1 received core stabilisation exercise programme, group 2 received core stabilisation plus dynamic resistance exercise programme and group 3 received stabilisation, dynamic resistance plus static exercise programme. They used computerised tomography (CT) and magnetic resonance image (MRI) to measure the cross sectional area of paravertebral muscles. The results suggested that there was significant reduction in muscle atrophy in-group 3 and no differences in-group 1 and 2. There was no follow up and researchers did not measure pain neither used any functional measures. It is impossible to establish whether reduction in muscle atrophy would have any effect on patient symptoms. Due to this reason the results of this study is not transferable directly to clinical practice. It will be interesting to

conduct a study with longer period follow up and to see whether changes in muscle atrophy would have any relationship with chronic low back pain. Kasai³⁴ published a review paper comparing dynamic strengthening exercise programme with lumbar spine segmented stabilisation exercise programme. The author systemically evaluated randomised control trails (RCT) research papers published in the past. He used changes in pain level, ability to carry out functional task and improvement in physical status as outcomes to review the research papers. He concluded that both strengthening and stabilisation exercises appeared to be having a positive impact on level of pain, functional task ability and physical status in treating low back pain. He stated that the lumbar stabilisation exercises showed a high quality evidences as compared to strengthening exercise secondary to methodological superiority. On the basis of derived evidences from the literatures, he argued that lumbar stability exercise seems to be beneficial as compared to strengthening exercises in chronic low back pain moreover concluded his findings regarding exercise management for chronic low back pain on the basis of methodological flaws or strengths, and chose to be one of the hardest way to review articles as each reader review article at different methodological standard (accepted or unaccepted values with regard to methodology). In contrast a systematic review conducted by Rackwitz and his colleagues to explore the role of lumbar spine stability exercise in low back pain. Outcome used were level of pain, pain reoccurrence, level of disability and return to work.¹⁹ They selected seven randomised controlled trails in their study comparing core stability exercises with conventional physiotherapy interventions. They concluded that there is no significant evidence to suggest that lumbar stabilisation exercise is more effective with regard to other physiotherapy treatment options (strengthening exercises etc). Several studies compared core stability exercises with manual therapy. Goldby *et al.*²³ compared spinal stabilisation, manual therapy with minimum intervention. In this (n=213) subjects RCT group A (n=84) subjects received spinal stability exercises, group B (n=89) subjects received spinal manipulation and group C (n=40) subjects were given advise through an ineffective booklet comparable to controls. The results suggested that spinal stabilisation exercise program significantly reduced disability, medication use and improved quality of life as compared to manual therapy and control group. This is generally a good quality RCT that used multiple outcome measures, stratification method of randomisation and a follow up period of 12 months. The stability exercises group received intervention in a group and had extra level of peer support, education and patient empowerment. This extra level of support and 30% dropout rate in control group can influence results. Secondly it is possible that chronic low back pain subjects comprise high lumber instability and therefore responded better to stability exercises. Further research is required to determine which subgroup of patients would respond best to lumber stability or manipulative therapy interventions. In another similar type of small sample (n=47) subjects study Rasmussen-Barr *et al.*³⁵ compared core stability exercises with manual therapy. The results suggested that core stability exercises significantly reduced the symptoms over 6 weeks. The concern is stabilisation group only performed exercise for 6 weeks and still found effective. study has shown that patients took 2-3 weeks to learn isolated contraction of abdominal muscles. The author did not mention any monitoring process and it is difficult to assess patient's compliance with home exercise programme. In future studies inclusion of longer period of exercise (8-10) weeks and

monitoring of compliance with self maintain diaries would provide more credibility to the results.³⁶

In contrast, RCT looked at the effect of adding lumbar segmental stabilisation exercises regime to conventional/ traditional physiotherapy input for clients with recurrent chronic low back pain. In this study (n= 97) subjects between the ages of 18 to 60 years were recruited. Group one received conventional physiotherapy consisting of active general strengthening exercises and manual therapy whilst group two received conventional physiotherapy input with specific core stability exercises. Roland Morris Disability Questionnaire score, level of pain, quality of life and psychological measurement were taken at 6 and 12 months. The results suggested that both group subjects had improvement at similar level. There was no significant benefit of additional core stability exercises with active general strengthening exercises and manual therapy. Both groups (one and two) demonstrated improvement in pain level and quality of life in Roland Morris disability questionnaire but it was not statistically significant. In this study, the drop out rate from baseline to month 12 seems to be significant (baseline 97 subjects, at 12 month 68 subjects) and overall drop out rate is about 30%. The significant drop out rate of this study could impact on the results of this study. The author could have included the available data of drop out subjects in the data analysis.³⁷

All of the above studies did not mention which subgroup of CLBP patients would respond best to core stability exercises. Hicks³⁸ conducted a cohort study with sample size (n=54) to find out a clinical prediction rule to determine response of treatment to a stabilisation physiotherapy exercise programme for patients with nonradicular low back pain. In their study, all subjects received stabilisation exercise twice a week for 8 weeks with self-home exercise programme on daily basis. Instruction was given to all subjects to record home exercise activities in a compliance logbook. The authors used Ostwestry disability questionnaire as outcome measure on baseline and after 8 weeks of stabilisation exercises. They found that age < 40, SLR > 91°, present aberrant movement and positive prone instability test for lumbar spine are the predictors for successful core stabilisation exercise programme. The findings or predictors of this study appeared to be hard to transfer for all low back patients e.g over 50 years old patient group or sedentary life style patient. There are two main reasons for this arguments, firstly the mean age of this study was 42 year and secondly all subjects seems to have a active sorts job as this study was conducted in an outpatient clinic at Air Force base. More studies with inclusion of patients with wide age range and in community setting will be required in future research.

DISCUSSIONS:

Few studies compared specific core stability exercises with general strengthening exercises in chronic low back pain.^{17,29,31,34} Overall there was no benefit of using core stability exercises in addition to general trunk strengthening exercises. It is difficult to compare these studies due to use of various methodologies and outcome measures. Some of the studies did not follow up patients for longer period whereas other did not use functional outcome measures and the results of these studies appeared hard to be transferred to clinical practice due to small sample size. In terms of clinical application these studies did not classify which patients group would respond best to core stability exercises or general strengthening exercises. Two studies showed core stability exercises significantly improved outcomes when compared to manual therapy.^{23,35} One

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of the significant finding of Rasmussen-Bar *et al.*³⁵ study was that majority of patients included in this trail displayed clinical pattern of lumbar instability and may have respond best to core stability exercises. These findings are supported by a study stated that core stability exercises were more effective when applied to patients who have radiological diagnosis of lumbar instability.³⁶ One cohort study Hicks *et al.* demonstrated a clinical prediction rule to determine response to core stability exercises.³⁸ Findings were age < 40 and SLR > 91 degrees; present aberrant movement and positive prone instability test for lumbar spine are the predictors for successful core stability exercise programme. However, in this study the average age of the participants was 42 year and the results of this study cannot be transferred directly to clinical practice. Further research is required in wider age group population. Chronic low back pain has been misinterpreted in research and general thought is that majority of chronic low back pain patients share a uniform pattern and diagnosis and prognosis. What it means is that clinicians are not very good in the classification of sub groups into discrete group needing individualised care.³⁹ The question arises here is there any subgroups of lumbar instability in patients who have chronic low back. Efforts to classify chronic low back population according to lumbar instability have been started. O'sullivan¹⁴ classified lumbar instability based on motor control and movement pattern. However, this area of work is still in its infancy and further research is required in this area.

CONCLUSIONS:

In the literature there is a trend to use lumbar stability muscles exercises more with other treatment options, and it is noted that traditional physiotherapy input such as general exercises for low back pain based on strengthening exercises, fitness training, endurance programme and functional tasks exercises still have room in treating low back pain. It seems that core stability exercise is more effective than manual therapy. Overall research opinion seems to be divided as some research suggest that core stability exercises is the best option in treating low back pain whilst other found no significant difference with regard to general strengthening exercise or other treatment regime. In future research, there is a need to carry out more high quality research to clarify which subgroup of CLBP patients would respond best to core stability exercises or any other physiotherapy treatment option.

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