EVALUATION OF SPECIFIC STABILIZATION EXERCISES TO IMPROVE LUMBAR INSTABILITY

AN EXPERIMENTAL STUDY

BY

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DECLERATION

I, Mustafa Najmuddin , do declare that this thesis entitled “EVALUATION OF SPECIFIC STABILIZATION EXERCISES TO IMPROVE LUMBAR INSTABILITY ” is representative of my own work in both conception and execution under the the guidance of Mr Mustansir Hussain Zaidi (Supervisor), Liaquat National School Of Physiotherapy (LNSOP), Karachi.

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Supervisor Certificate

This is to certify that the research project/ thesis entitled **"EVALUATION OF SPECIFIC STABILIZATION EXERCISES TO IMPROVE LUMBAR INSTABILITY** " is a genuine research work done by **MUSTAFA NAMUDDIN** in partial fulfilment of the requirement for the degree of Master of Science Physiotherapy (M.Sc PT.) in **"NEURO-MUSCULOSKELETAL PHYSIOTHERAPY".** This thesis has not been submitted in any other university or institution previously for the award of a degree.

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DEDICATION

With the immense pleasure I dedicate this work to my parents, for their undying love and support through the long years of hard work. You have been my pillar of strength and inspiration and will continue to be a guiding light in my future.

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ABBREVATIONS

LBP----------low back pain

CLBP----------chronic low back pain.

NC----------neurogenic claudication.

DS----------degenrative spondylolisthesis

TA----------transverse abdominals

MF----------multifidus

IO----------internal obligue

TLF----------thoracolumbar fascia

IAP----------intra abdominal pressure

CT----------comptued tomography

MRI----------magnetic resonanat imaging

SAP----------superior articular process

ET----------exercise therapy

TENS----------transcutaneus electrical nerve stimulation

IDET----------intra discal electrothermaltherapy

RPA----------radiofrequency post annuloplasty.

ABSTRACT

Study Design. A randomized, controlled trial, test-retest design.

Objective. Evaluation of specific stabilization exercise intervention in the treatment of patients with lumbar instability and a radiologic diagnosis of spondylosis or spondylolisthesis.

Background . A recent focus in the physiotherapy management of patients with back pain has been the specific training of muscles surrounding the spine (deep abdominal muscles and lumbar multifidus), considered to provide dynamic stability and fine control to the lumbar spine. In no study have researchers evaluated the efficacy of this intervention in a population with chronic low back pain where the anatomic stability of the spine was compromised.

Methods. Fifty patients with this condition were assigned randomly. They underwent specific exercise treatment program involving the specific training of the deep abdominal Muscles, with co-activation of the lumbar multifidus proximal to the pars defects. The activation of these muscles was incorporated into previously aggravating static postures and functional tasks.

Results. After intervention, the subject showed a statistically significant reduction in pain intensity and functional disability levels.

Conclusion. A "specific exercise" treatment approach appears more effective than other commonly prescribed conservative treatment programs in patients with chronically symptomatic spondylosis or spondylolisthesis.

CHAPTER # 1

1.0 INTRODUCTION:

Lumbar instability was considered to be significant factor in patient with chronic low back pain (CLBP). However, there was considerable debate as to what exactly constitutes spinal instability. Panjabi redefined spinal instability in term of a region laxity around the neutral resting position of a spinal segment called the "neutral zone". This neutral zone was shown to be larger with intersegemntal injury and intervertebral disc degeneration and smaller with stimulated muscle forces across a motion segment. In this way, the size of neutral zone was considered to be a important measure of spinal stability. It was influenced by the interaction between what Panjabi described as the passive, active and neutral control systems. The passive system constituting the vertebrae, intervertebral disc, zygapophyseal joints, and ligaments; the active system constituting the muscles and tendons surrounding and acting on the spinal column; and the neural system comprising the nerves and central nervous system, which direct and control the active system in providing dynamic stability. Panjabi then defined spinal instability as a significant decrease in the capacity of the stabilizing systems of the spine to maintain intervertebral neutral zone within physiologic limits, there is no major deformity, neurologic deficit, or incapacitating pain[1].

One of the limitations in the clinical diagnosis of lumbar instability lies in the difficulty to detect accurately abnormal or excessive intersegmental motion, because conventional radiological testing was often reported to be insensitive and unreliable. Traditionally, the radiologic diagnosis of spondylosis and spondylolisthesis in patients with CLBP attributable to these finding, has been considered to be one of the most obvious manifestation of lumbar instability with a number of studies reporting increased translational and rotational motion occurring segmentally in the presence of this condition[2].

Spinal instability is not a single disease but a pathophysiological consequence of a variety of different spinal disorder and degenerative conditions, each with its own epidemiology it is not possible or meaning full to determine the incidence and prevalence of spinal instability in the population.

A wide range of conservative interventions has been advocated for the treatment of this condition when it is chronically symptomatic. These interventions include orthotic bracing, flexion exercises and general aerobics exercise such as swimming and walking. However few clinical

trials have evaluated the effectiveness of these different conservative measures for this clinical problem that may result in surgical fusion[3].

The vast majority of surgery performs annually for this condition. By stabilizing try to overcome the risk of surgery and people are more shifted towards conservative treatment.

The specific sub maximal training of these stability muscles of lumbar spine and the integration of these training into functional tasks decrease both pain and functional disability in those suffering from mechanical LBP. Clinically, this approach appears particularly effective where the segmental stability of the lumbar spine has been compromised. It was hypothesized that, where the integrity of the passive stabilizing structures of the lumbar spine has been compromised. The neuromuscular system may play an important role in providing dynamic stability to the segment.

The stability of basic morphology of the lumbar spine in compromise specific training of the muscles considered to provide dynamic stability of the lumbar spine. Specific exercise treatment approach is more effective than other conservative treatment approaches commonly used in patient with this condition. The deep trunk muscles, Transversus Abdominis (TA), multifidus (MF), Internal Oblique (IO), paraspinal, pelvic floor, are key to the active support of the lumbar spine. The co-contraction of these muscles produce forces via the "thoracolumbar fascia" (TLF) and the "intra-abdominal pressure" (IAP) mechanism which stabilise the lumbar spine, and the paraspinal and MF muscles act directly to resist the forces acting on the lumbar spine. The co-contraction of the TA and MF muscles occurred prior to any movement of the limbs. This suggests that these muscles anticipate dynamic forces that may act on the lumbar spine and stabilise the area prior to any movement[4].

Recently, there has been a focus on exercises that aim to maintain/improve lumbar spine stability. Although no formal definition of lumbar stabilization exercises exists, the approach is aimed at improving the neuromuscular control, strength, and endurance of the muscles that are central to maintaining the dynamic spinal and trunk stability. Several groups of muscles particularly targeted the transversus abdominis and lumbar multifidis, but also other paraspinal, abdominal, diaphragmatic, and pelvic muscles.

Unsubstantiated suggestions that stabilization training may be useful in reducing pain and disability for all patients with nonspecific LBP, have appeared in the literature , but these assertions have not been definitively demonstrated. The overwhelming majority of studies on lumbar stabilization exercises use mixed groups (including patients with disc lesions, osteoarthritis, or leg pain) of subjects with nonspecific chronic LBP. These studies cannot determine whether a specific subgroup of patients may be more responsive to lumbar stabilization exercises. Also, no randomized controlled trials have measured the maximal isometric contraction strength of lumbar extensors at different angles of lumbar flexion. Therefore, the aim of this study was to compare the effects of lumbar stabilization exercises and lumbar dynamic strengthening exercises on the maximal isometric contraction strength of the lumbar extensors, pain severity, and functional disability in patients with nonspecific chronic LBP5.

1.1 SPONDYLOSIS:

Spondylosis is a term with many definitions. In the literature, it has been utilized in many different contexts, employed synonymously with arthrosis, spondylitis, hypertrophic arthritis, and osteoarthritis. In other instances, spondylosis is considered mechanistically, as the hypertrophic response of adjacent vertebral bone to disk degeneration (although osteophytes may infrequently form in the absence of diseased disks). Finally, spondylosis may be applied nonspecifically to any and all degenerative conditions affecting the disks, vertebral bodies, and/or associated joints of the lumbar spine. For purposes of this review, we will use this final, broad definition of spondylosis, recognizing the high incidence of coincident degenerative changes, and the dynamic interplay between adjacent disks, vertebra, and nerves that create the clinical pain syndromes within the axial spine and associated nerves[6].

1.1 a. CLINICAL PRESENTATION:

Pain within the axial spine at the site of these degenerate changes is not surprising as nociceptive pain generators have been identified within facet joints, intervertebral disks, sacroiliac joints, nerve root dura, and myofascial structures within the axial spine[7].

These degenerative anatomical changes may culminate in a clinical presentation of spinal stenosis, or narrowing within the spinal canal through progressive ingrowth of osteophytes, hypertrophy of the inferior articular process, disk herniation, bulging of the ligamentum flavum, or spondylolisthesis. The clinical result: a constellation of pain symptoms encompassed in the term *neurogenic claudication* (NC). NC may include (to varying extents) lower back pain, leg pain, as well as numbness and motor weakness to lower extremities that worsen with upright stance and walking, and improve with sitting and supine positioning[8].

Clinical presentations of radiculopathy may emanate from many sources, all of which can be explained by the degenerative process. Disk bulging may affect descending rootlets of the cauda equina, nerve roots exiting at the next lower intervertebral canal, or the spinal nerve within its ventral ramus, if protruding centrally, posterolaterally, or laterally, respectively. Osteophyte lipping along the posterior aspect of vertebral bodies, along upper or lower margins, may similarly impinge upon the same neural structures as the bulging disk just described. Hypertrophic changes to the superior articular process may intrude upon nerve roots within the upper nerve root canal, dural sac, or prior to exiting from next lower intervertebral canal, depending on their projection. These theoretical forms of impingement have been substantiated through cadaver studies. A 70% reduction or 30% residual diameter of neuroforminal space is cited as the critical amount of occlusion to induce neural compromise. Moreover, compression of the posterior disk to less than 4 mm height, or foraminal height to less than 15 mm has also been determined as critical dimensions for foraminal stenosis and nerve impingement[9].

A diagnostic Approach:

The initial evaluation for patients with low back pain begins with an accurate history and thorough physical exam with appropriate provocative testing. These first steps are complicated by the subjectivity of patient experiences of chronic spinal pain and the inherent difficulty isolating the anatomic region of interest during provocative testing without the influence of neighboring structures.

Radiographic studies, whether plain film, CT, CT myelogram, or MRI, may provide useful confirmatory evidence to support an exam finding and localize a degenerative lesion or area of nerve compression. However, imaging is an imperfect science, identifying the underlying cause

of LBP in only 15% of patients in the absence of clear disk herniation or neurological deficit. Furthermore, there remains a frequent disconnection between the symptom severity and the degree of anatomical or radiographic changes. While correlations between the number and severity of osteophytes and back pain exist, the prevalence of degenerative changes among asymptomatic patients underlies the difficulty assigning clinical relevance to observed radiographic changes in patients with LBP[10].

Nerve compression symptoms by clinical history may also be confirmed by electromyographic studies demonstrating normal distal motor and sensory nerve conduction studies with abnormal needle exam. Diagnostic injections can facilitate localization by isolating and anesthetizing irritated nerve roots (via epidural), or by blocking suspected pain generators within facet joints, sacroiliac joints, or the disk space itself (via Discography) [11].

1.1b. PATHOGENESIS:

The high incidence of simultaneous degenerative changes to the intervertebral disk, vertebral body, and associated joints suggests a progressive and dynamic mechanism, with interdependent changes occurring secondary to disk space narrowing[12].

Intervertebral disks are believed to undergo what Kirkaldy Willis and Bernard first coined a "degenerative cascade" of three overlapping phases that may occur over the course of decades. Phase I (Dysfunction Phase) describes the initial effects of repetitive microtrauma with the development of circumferential painful tears of the outer, innervated anulus, and associated end-plate separation that may compromise disk nutritional supply and waste removal. Such tears may coalesce to become radial tears, more prone to protrusion, and impact the disk's capacity to maintain water, resulting in desiccation and reduced disk height. Fissures may become ingrown by vascular tissue and nerve endings, increasing innervation and the disk's capacity for pain signal transmission. Phase II (Instability Phase) is characterized by the loss of mechanical integrity, with progressive disk changes of resorption, internal disruption, and additional annular tears, combined with further facet degeneration that may induce subluxation and instability. During Phase III (Stabilization Phase), continued disk space narrowing and fibrosis occurs along with the formation of osteophytes and transdiscal bridging[13].

Schneck presents a further mechanical progression, building upon this degenerative cascade of the intervertebral disk, to explain other degenerative changes of the axial spine. He proposes several implications of disk space narrowing. Adjacent pedicles approximate with a narrowing of the superior–inferior dimension of the intervertebral canal. Laxity due to modest redundancy of the longitudinal ligaments enables bulging of the ligamentum flavum and potential for spine instability. Increased spine movement permits subluxation of the superior articular process (SAP), causing a narrowed anteroposterior dimension of the intervertebral and upper nerve root canals. Laxity may also translate into altered weight mechanisms and pressure relationships on vertebral bone and joint spaces believed to influence osteophyte formation and facet hypertrophy to both inferior and superior articular processes with risks for projection into the intervertebral canal and central canal, respectively. Oblique orientations of the articular processes may further cause retrospondylolisthesis, with resulting anterior encroachment of the spinal canal, nerve root canal, and intervertebral canal[14].

Biochemical research exploring osteophyte formation supports the above process. Osteophyte lipping is believed to form at periosteum, through the proliferation of peripheral articular cartilage which subsequently undergoes endochondral calcification and ossification. Changing weight mechanics and pressure forces as well as alterations in oxygen tension and dynamic fluid pressure appear to be influential factors in osteophyte formation. Mesenchymal stem cells of the synovium or periostium are likely precursors, with synovial macrophages and a milieu of growth factors and extracellular matrix molecules acting as probable mediators in this process[15].

1.2 DEGENERATIVE SPONDYLOLISTHESIS:

Degenerative spondylolisthesis (DS) is a disorder that causes the slip of one vertebral body over the one below. It differs from spondylolytic spondylolisthesis by the absence of a pars interarticularis defect (spondylolysis), i.e., in DS the whole upper vertebra (vertebral body and posterior part of the vertebra including neural arch and processes) slips relative to the lower vertebra. In a congenital spondylolisthesis, sometimes due to dysplastic facets with intact pars interarticularis the whole upper vertebra, can slip forward and cause spinal stenosis with potential impingement of cauda equine or spinal nerve roots. However, symptoms in this type of listhesis usually develop during the adolescent growth period, and not as in DS, where symptoms develop in patients older than 40. DS can be found in classifications of spondylolisthesis, spinal stenosis, and segmental instability, indicating that the clinical presentation is varied. As the neural arch is intact, even a small progression in the slip can result in cauda equina compression. Symptoms and treatments of DS considered as one of the major causes of low back pain (LBP) among the elderly and is a major cause of spinal canal stenosis related to low back and leg pain. Other types of spondylolisthesis and surgical treatments will not be discussed[16].

The clinical symptoms of degenerative spondylolisthesis, however, are varied. Patients with degenerative lumbar spondylolisthesis can be asymptomatic. They can also present with back pain, or with neurogenic claudication and/or radicular pain, with or without axial back pain. Therefore, the work group agreed upon this anatomic definition, but also evaluated the relevant literature inclusive of the variations of clinical presentation.

The most probable sources for signs and symptoms related to DS are: (1) degenerated and subluxated facet joints; (2) segmental instability that cause tension of facet joint capsule and ligaments as well as overuse of stabilization muscles; and (3) spinal stenosis and intervertebral foramen stenosis. Lumbar DS is a major cause of spinal canal stenosis and is often related to low back and leg pain. The most common complaint of patients with DS is back pain. Often the pain has been episodic and recurrent for many years. As is the case with all mechanical back pain, patients usually report that their symptoms vary as a function of mechanical loads (such as in going from supine to erect position) imposed, and pain frequently worsens over the course of the day. Radiation into the posterolateral thighs is also common and is independent of neurologic

signs and symptoms. The advent of leg symptoms is the most common reason why patients and referring physicians become truly concerned and seek specialized medical attention. The pain may be diffuse in the lower extremities, involving the L5 and/or L4 roots unilaterally or bilaterally. One of the most characteristic symptoms of DS with stenosis is leg pain that shifts from side to side. One time the patient will complain of neurogenic pain in one leg and another time will complain of the opposite leg. Monoradiculopathy is the less common type of leg pain; when present, it is the result of entrapment of the L5 root in the lateral recess. Another common pain presentation is that of neurogenic claudication. Symptoms of neurogenic claudication that cause the patient to stop and sit after less than two blocks of walking usually correspond to the time, when the patient consents to surgery. Additional complaints include cold feet, altered gait, and "drop episodes," wherein the patient unexpectedly falls while walking[17].

1.2 a. DIAGNOSTIC APPROACH:

The primary role of imaging studies is to confirm the clinical diagnosis of DS, although advanced imaging studies are also essential for preoperative planning. The plain radiographic features include the essential finding on a lateral view of forward displacement of L4 on L5 or, more rarely, L5 on S1 or L3 on L4 in the presence of an intact neural arch. Defect of pars interarticularis (which has the appearance of a Scottie dog with a collar) that can be seen on lateral or bilateral oblique views helps to distinguish between DS and isthmic spondylolisthesis. Since in DS the neural arch is intact, the spinous process moves forward with the vertebral body. This results in malalignment of the spinous processes, which can be identified on lateral radiographs. The additional findings are usually consistent with a long-standing degenerative process and include disk-space narrowing, vacuum sign, endplate sclerosis, peridiscal osteophytes, and facet sclerosis and hypertrophy. The anteroposterior radiograph often, but not always, demonstrates the accompanying hemisacralization of L5[18]

. Additional imaging studies may be warranted depending on the patient's presentation and the clinical findings. Factors that speak about the need for further imaging include significant and progressing neurologic claudication or radiculopathies and the clinical suspicion that another condition, such as metastatic disease, may be causative. An absolute indication is the presence of bladder or bowel complaints[19].

The imaging alternatives include computed tomography (CT), myelography, contrast material-enhanced CT, and magnetic resonance imaging (MRI). CT of the spine can be performed with or without intrathecal contrast enhancement. Axial images are obtained in a plane parallel to the disk spaces at each level imaged. CT shows the alignment of the facet joints and their degenerative changes. Asymmetrical slip of the facets results in a rotational component to the spondylolisthesis.

1.3 **INTERVENTION AND DIFFERENT TREATMENT OPTION**

Given our limited ability to isolate causative sources of chronic lower back pain, there is a little consensus with regard to a definitive treatment approach. Substantial variation in management by conservative and invasive approaches exists between practitioners throughout the country. We will briefly describe these treatment options for the management of chronic low back pain syndromes within each of the four primary categories: physical therapy (and associated modalities and behavioral techniques), pharmacotherapy, injection therapy, and surgical intervention.

1.3a.Exercise-based and behavioral interventions

1.3a(1) Exercise therapy

Exercise therapy (ET) remains one of the conservative mainstays of treatment for chronic lumbar spine pain, and may be tailored to include aerobic exercise, muscle strengthening, and stretching exercises. Significant variation in regimen, intensity, and frequency of prescribed programs presents challenges to assessing efficacy among patients. One meta-analysis of the current literature exploring the role of ET in patients with varying duration of symptoms found a graded exercise program implemented within the occupational setting demonstrated some effectiveness in subacute LBP. Among those suffering chronic pain symptoms, small, but statistically significant improvements were observed among patients, with regard to pain reduction and functional improvement. The optimal approach to exercise therapy in chronic low back pain sufferers appears to be those regimens involving an individually-designed exercise program emphasizing stretching and muscle strengthening, administered in a supervised fashion, with

high frequency and close adherence. Such results are complemented by other conservative approaches, including NSAIDS, manual therapies, and daily physical activity[20].

1.3a(2) Transcutaneous electrical nerve stimulation (TENS)

A "TENS" unit is a therapeutic modality involving skin surface electrodes which deliver electrical stimulation to peripheral nerves in an effort to relieve pain noninvasively. Such devices are frequently available in outpatient exercise therapy settings, with up to a third of patients experiencing mild skin irritation following treatment. While one small study identified an immediate reduction in pain symptoms 1 h following TENS application, there remains little evidence of long-term relief. Another larger study did not discover significant improvement with TENS compared with placebo with regard to pain, functional status, or range of motion[21].

1.3a(3) Back school

Back School was introduced first in Sweden with the purpose of minimizing lower back pain symptoms and their reoccurrence through review with patients of lumbar anatomy, concepts of posture, ergonomics, and appropriate back exercises. Two meta-analyses concluded that there is moderate evidence for improvement in both pain and functional status for chronic low back pain within short and intermediate time courses, when measured against other modalities such as exercise, joint manipulation, myofascial therapy, and/or other educational therapy[22].

1.3a(4) Lumbar supports

Lumbar back supports may provide benefit to patients suffering chronic LBP secondary to degenerative processes through several potential, debated mechanisms. Supports are designed to limit spine motion, stabilize, correct deformity, and reduce mechanical forces. They may further have effects by massaging painful areas and applying beneficial heat; however, they may also function as a placebo. There is moderate available evidence evaluating efficacy of lumbar supports within a mixed population of acute, subacute, and chronic LBP sufferers to suggest that lumbar supports are not more effective than other treatment forms; data is conflicting with regard to patient improvement and functional ability to return to work[23].

1.03a(5) Traction

Lumbar traction applies a longitudinal force to the axial spine through use of a harness attached to the iliac crest and lower rib cage to relieve chronic low back pain. The forces, which open

intervertebral space and decrease spine lordosis, are adjusted both with regard to level and duration and may closely be measured in motorized and bed rest devices. Temporary spine realignments are theorized to improve symptoms related to degenerative spine disease by relieving mechanical stress, nerve compression, and adhesions of the facet and annulus, as well as through disruption of nociceptive pain signals. Nonetheless, patients with chronic symptoms and radicular pain have not found traction to provide significant improvement in pain nor daily functioning . Little is known with regard to the risks associated with the applied forces. Isolated case reports cite nerve impingement with heavy forces, and the potential for respiratory constraints or blood pressure changes due to the harness placement and positioning24.

1.3a(6) Spine Manipulation

Spine manipulation is a manual therapy approach involving low-velocity, long lever manipulation of a joint beyond the accustomed, but not anatomical range of motion. The precise mechanism for improvement in low back pain sufferers remains unclear. Manipulative therapy may function through: "(1) release for the entrapped synovial folds, (2) relaxation of hypertonic muscle, (3) disruption of articular or periarticular adhesion, (4) unbuckling of motion segments that have undergone disproportionate displacement, (5) reduction of disk bulge, (6) repositioning of miniscule structures within the articular surface, (7) mechanical stimulation of nociceptive joint fibers, (8) change in neurophysiological function, and (9) reduction of muscle spasm[25].

Available research regarding its efficacy in the context of chronic LBP finds spinal manipulation to be "more effective" compared to sham manipulation with regard to both short- and long-term relief of pain, as well as short-term functional improvement. Compared with other conventional, conservative treatment approaches such as exercise therapy, back school, and NSAID prescription, spinal manipulation appears comparable in its effectiveness both in short- and long-term benefits,. Research exploring the safety of such therapy among trained therapists found a very low risk of complications, with clinically worsened disk herniation or cauda equina syndrome occurring in fewer than 1/3.7 million[26].

1.3a(7) Massage therapy

Massage therapy for chronic LBP appears to provide some beneficial relief. Weighed against other interventions, it proved less efficacious than TENS and manipulation, comparable with corsets and exercise regimens, and superior to acupuncture and other relaxation therapies, when

followed over a 1-year course. Such preliminary results need confirmation, and evaluation for cost-effectiveness, but nevertheless suggest a potential role in certain, interested patients[27].

1.3b Multidisciplinary back therapy: the bio-psychosocial approach

Psychopathology is well recognized for its association with chronic spinal pain, and, when untreated, its ability to compromise management efforts. For this reason, patients may find relief through learned cognitive strategies, termed "behavioral", or "bio-psychosocial" therapy. Strategies involving reinforcement, modified expectations, imagery/relaxation techniques, and learned control of physiological responses aim to reduce a patient's perception of disability and pain symptoms. To date, evidence is limited with regard to the efficacy of operant, cognitive, and respondent treatment approaches[28].

1.3b(1) Pharmacotherapy

Treatment efforts to control pain and swelling, minimize disability, and improve the quality of life with lumbar spondylosis often require medication to complement nonpharmacologic interventions. Extensive research efforts have explored the efficacy of different oral medications in the management of low back pain secondary to degenerative processes. Nonetheless, there remains no clear consensus regarding the gold-standard approach to pharmacologic management[29].

1.3b(2) NSAIDS

NSAIDS are widely regarded as an appropriate first step in management, providing analgesic and anti-inflammatory effects. There is adequate data demonstrating efficacy in pain reduction in the context of chronic low back pain. with use most commonly limited by gastrointestinal (GI) complaints. COX2 inhibitors offer modest relief in chronic LBP and improved function in the long-term setting. While they elicit fewer GI complications, their utilization has been curbed due to evidence for increased cardiovascular risk with prolonged use[30].

1.3b(3) Opioid Medications

Opioid medications may be considered as an alternative or augmentive therapy for patients suffering from gastrointestinal effects or poor pain control on NSAID management. The practice of prescribing narcotics for chronic low back pain sufferers is extremely variable within practitioners, with a range of 3–66% of chronic LBP patients taking some form of opioid in

various literature studies. These patients tend to report greater distress/suffering and higher functional disability scores. Two meta-analyses suggest a modest short-term benefit of opioid use for treatment of chronic LBP while issuing a warning regarding the limited quality of available studies and the high rate of tolerance and abuse associated with long-term narcotic use within this patient population[31].

1.3b(4) Antidepressants

The use of antidepressants for treatment of LBP symptoms has also been explored considerably given their proposed analgesic value at low doses, and dual role in treatment of commonly comorbid depression that accompanies LBP and may negatively impact both sleep and pain tolerance. Two separate reviews of available literature found evidence for pain relief with antidepressants, but no significant impact on functioning[32].

1.3b(5) Muscle Relaxants

Muscle relaxants, taking the form of either antispasmodic or antispasticity medications, may provide benefit in chronic low back pain attributed to degenerative conditions. There remains moderate to strong evidence through several trials comparing either a benzodiazepine, or non-benzodiazepine with placebo that muscle relaxants provide benefit with regard to short-term pain relief and overall functioning[33].

1.3c Injection Therapy

1.3c(1) Epidural steroid injections

Epidural steroid injections (ESI) have become a common interventional strategy in the management of chronic axial and radicular pain due to degeneration of the lumbar spine. These injections may be performed through interlaminar, transforaminal, or caudal approaches. Usually by way of needles guided under fluoroscopy, contrast, then local anesthetic and steroid are infused into the epidural space at the target vertebral level and bathe exiting nerve roots. Symptomatic relief is theorized to occur through complementary mechanisms. Local anesthetics provide quick diagnostic confirmation, and therapeutically may short circuit the “pain spasm cycle” and block pain signal transmission. Corticosteroids are well recognized for their capacity to reduce inflammation through blockade of pro-inflammatory mediators[34].

The review evaluating the transforaminal injection approach to unilateral sciatica found strong evidence for short-term, and moderate evidence for long-term symptom and functional improvement, based on the findings from several RCT. Vad et al. studied 48 patients with herniated nucleus pulposus or radicular pain, treated with transforaminal ESI versus trigger point injections, citing an 84% improvement in functional scoring compared with 48% in the control group, extending for a follow-up period of 1 year. Lutz et al treated and followed a different cohort of 69 patients with the same underlying diagnoses, with transforaminal ESI for 80 weeks demonstrating 75% of patients with a successful long-term outcome, defined as >50% reduction in pain scores. In spinal stenosis, transforaminal ESI has achieved >50% pain reduction, improved walking, and improved standing tolerance in symptomatic patients extending through 1 year follow-up . Furthermore, prospective trials by Yang and Riew found patients with severe lumbar radiculopathies and spinal stenosis treated with transforaminal injections experienced such sustained functional and symptomatic benefits so as to avoid intended surgical intervention[35].

1.3c(2) Facet injections

Facet joints, also termed zygapophysial joints, are paired diarthrodial articulations between adjacent vertebrae. These joints are innervated from the medial branches of the dorsal rami and, through anatomical studies, possess free and encapsulated nerve endings, mechanoreceptors, and nociceptors. Inflammation to the joint creates pain signals which are implicated in 15–45% of patients with low back pain[36].

Diagnostic blocks of the joint inject anesthesia directly into the joint space or associated medial branch. Systematic reviews of both retrospective and prospective trials reveal single diagnostic facet blocks carry a false-positive rate of 22% to 47% and medial branch blocks of 17–47% in the lumbar spine[37].

Subsequent therapeutic injections are similarly performed through either approach, with systematic reviews concluding moderate evidence available for short-term and long-term pain relief with facet blocks . This evidence stems from studies such as Fuch's RCT showing significant pain relief, functional improvement, and quality of life enhancement at 3 and 6 month intervals . By contrast, Carette et al. found no meaningful difference in perceived benefit between patients treated with steroid versus saline (control) injection at 3 and 6 month intervals.

Available literature of MBB similarly show moderate evidence for short- and long-term relief based on RCT of MBB under fluoroscopy, showing significant relief (by means of pain relief, physical health, psychological benefit, reduced narcotic intake, and employment status), with 1–3 injections in 100% patients at 3 months, 75–88% at 6 months, and 17–25% at 1 year[38].

1.3c(3) SI joint injections

The sacroiliac joint space is a diarthrodial synovial joint with debated innervation patterns that involve both myelinated and unmyelinated axons. Injury or inflammation at the joint creates pain signals which are implicated in 10–27% of patients with low back pain and may also refer to the buttocks, groin, thigh, and lower extremities.

A recent meta-analysis provided the following guiding principles with regard to the frequency these procedures should be implemented in clinical practice. In cases of, facet, and sacroiliac injections, diagnostic injections should be considered at intervals of no sooner than 1–2 weeks apart. Therapeutic injections may be performed at most every 2–3 months, provided the patient experiences greater than 50% relief within 6 weeks. Injections should be performed only as they are medically necessary given their associated risks and significant costs[39].

1.3d. Intradiscal nonoperative therapies for discogenic pain

Discogenic pain has been identified as the source in 39% of patients with chronic low back pain. As described above, a cascade of effects induces the changes in the disk which generate pain. Discography seeks, when noninvasive imaging has failed, to identify damaged disks through injection of fluid into disk levels, in an attempt to reproduce patient symptoms. The technique's utility remains controversial given significant potential for false positives. Provoked pain may be alternatively represent central hyperalgesia, reflect the patient's chronic pain or psychological state, or result from technical difficulty due to the procedure itself.

If a diseased disk is identified, several treatment options exist. In addition to surgical correction, there are minimally invasive options. Both Intradiscal electrothermal therapy and Radiofrequency posterior annuloplasty involve electrode placement into the disk. Heat and electrical current coagulate the posterior anulus, and in doing so, strengthen collagen fibers, seal figures, denature inflammatory exudates, and coagulate nociceptors. Current evidence provides

moderate support for IDET in discogenic pain sufferers. Preliminary studies of RPA provide limited support for short term relief, with indeterminate long-term value. Both procedures have associated complications, including catheter malfunction, nerve root injuries, post-procedure disk herniation, and infection risk[40].

1.3e. Surgical Options

Surgical interventions are generally reserved for patients who have failed conservative options. Patients must be considered as appropriate "surgical candidates," taking into consideration medical comorbidities as well as age, socioeconomic status, and projected activity level following a procedure . Many surgical approaches have been developed to achieve one of the two primary goals: spinal fusion or spine decompression (or both).

Spinal fusion is considered in patients with malalignment or excessive motion of the spine, as seen with DDD and spondylolisthesis. Several surgical fusion approaches exist, all involving the addition of a bone graft to grow between vertebral elements to limit associated motion. Decompression surgery is indicated for patients with clear evidence of neural impingement, correcting the intrusion of bone or disk as might be seen in spinal or foraminal stenosis, disk herniation, osteophytosis, or degenerative spondylolisthesis. Despite dramatic increases in the number of procedures performed over the last several decades, there remains controversy as to the efficacy of these procedures in resolving chronic low back unresponsive to conservative management.

Controversy arises, in part, due to the inherent challenges of comparing the available research. Systematic reviews cite the heterogeneity of current trials which evaluate different surgical techniques with differing comparison groups and limited follow-up, frequently without patient-centered or pain outcomes included . Some case series reveal promising results . Nonetheless, a recent meta-analysis of 31 randomized controlled trials, concluded, "[there is] no clear evidence about the most effective technique of decompression for spinal stenosis or the extent of that decompression. There is limited evidence that adjunct fusion to supplement decompression for degenerative spondylolisthesis produces less progressive slip and better clinical outcomes than decompression alone." Another review, noting no statistically significant improvement in patients undergoing fusion compared with nonsurgical interventions commented, "surgeons

should recommend spinal fusion cautiously to patients with chronic low back pain. Further long-term follow-ups of the studies reviewed in this meta-analysis are required to provide more conclusive evidence in favor of either treatment[41].

1.4. DYNAMIC STABILITY EXERCISE THE TREATMENT REGIEM

The human lumbar spine without muscles and viscera collapses easily. To allow movement, carry loads and protect the spinal cord and nerve roots “stability” is required. Stability is provided in a co-ordinated manner by the active (eg muscles), passive (eg lumbar spine) and control (eg neurological systems). There is controversy and some confusion on the definition of the term “core stability”. Traditionally this term has referred to the active component to the stabilizing system including deep/local muscles that provide segmental stability (eg transversus abdominis, lumbar multifidus) and/or the superficial/global muscles (eg rectus abdominis, erector spinae) that enable trunk movement/torque generation and also assist in stability in more physically demanding tasks. Different proponents have advocated different types of core stability exercises ranging from the abdominal drawing in maneuver (Figure 2)



Fig: 1. Core Stability Exercises[42]

1.5. CLINICALLY RELEVANT ANATOMY

1.5.a. Local Muscles:

The local/deep muscles have their origin or insertion on the lumbar vertebra therefore can exert a segmental stabilizing/stiffening effect. Standard texts provide detailed information on anatomy on key deep muscles and online resources are also available (see Figures 3and 4).

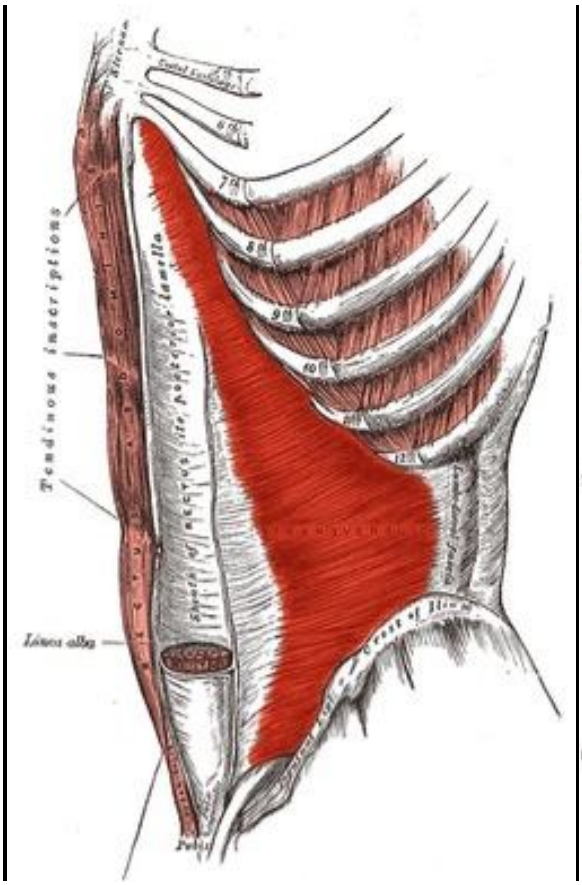


Figure 2: Transversus abdominis.

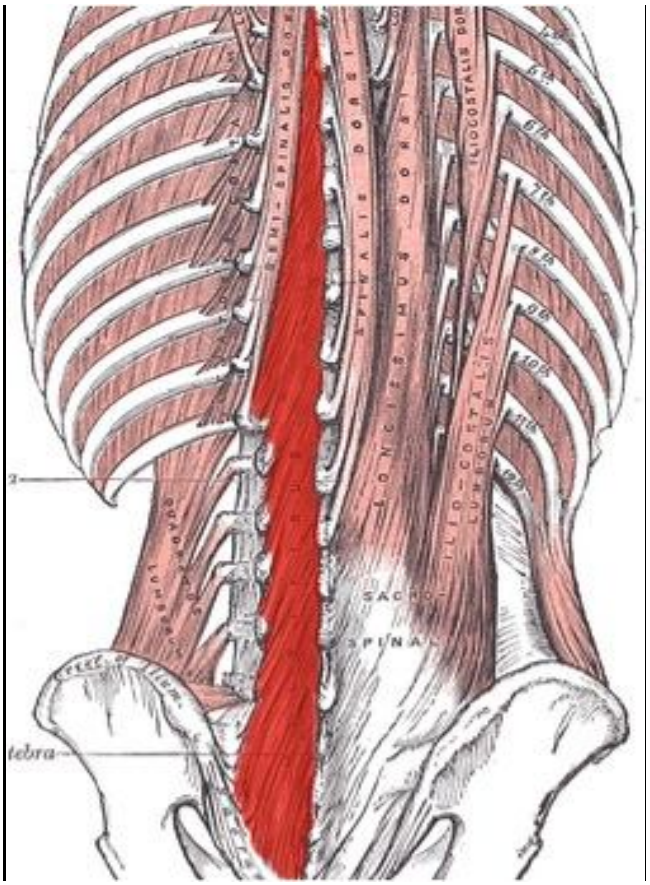


Figure 3: Lumbar multifidus on the left of the spine.

1.6.Muscles Of The Low Back:

STABILIZER	MOBILIZER
PRIMARY STABILIZER Multifidus Transverse abdominis Internal obligue Gluteus medius Vastus medialis Serratus anterior Lower trapzius Deep neck flexor SECONDARY STABILIZER Gluteus maximus Quadriceps Iliopsoas Subscapularis Infraspinatus Upper trapezius Quadaratus lumborum	Ilipsoas Hamstrings Rectus femoris Tensor fascia lata Hip adductors Piritormis Rectus abdominis External oblique Quadartus lumborum Erector spinae Sternomastoid Upper trapezius Levators scapulae Rhomboids Pecotralis major Pectoralis minor Sclanes

Table.1 Stabilizing and mobilizing muscles that affect the low back[43].

The mechanisms of the deep muscles and stability/stiffness are controversial but transverse abdominus may act like a canister with the diaphragm and pelvic floor muscles. This co-contraction increases the intra-abdominal pressure, which creates an extension moment at the spine and has been hypothesized as increasing stability/stiffness in particular via connections with the thoraco-lumbar fascia. The multifidus may increase the rotational segmental stability in a sagittal and horizontal plan.

1.7.INDICATIONS FOR EXERCISE

It has been shown that there are different reasons why we should give exercises to patients with lumbar instability. The most important considerations are; which are our goals and is the patient likely to benefit.

There are indications that stabilization exercise programs are used to improve the strength, endurance, and/or motor control of the abdominal and lumbar trunk musculature. Stabilization exercise programs exist of general exercises, educational and workplace-specific back school classes, increase of workload tolerance, psychological interventions and segmental stabilization exercises. The stabilizing exercises focus on the re-education of a precise co-contraction pattern of local muscles of the spine.

It had been showed that stabilizing exercises with routine exercises in reduction of pain intensity increasing the functional ability and muscle endurance. It is recommended to use stabilizing exercises in treatment of patients with lumbar segmental instability.

This is the guideline about the implications for practicing the local muscle system:

• Develop the skill of an independent contraction of the local muscle synergy;

• Decrease the contribution of the overactive global muscles;

• Use a motor relearning approach to reteach the skill of developing a “corset” action of transverses abdominis and multifidus in response to the cue to draw in the abdominal wall.

• Use specific facilitation and feedback techniques to ensure each segment of the multifidus muscle is activated;

• Use specific feedback techniques to develop kinaesthetic awareness of local muscle contractions;

• Develop ability to hold the “corset” action tonically over extended periods of time

• Use repeated movements of lumbopelvic region, in non-weightbearing positions initially, to improve position sense.

Implications for practice of the local muscle system with the global muscle system

• Training the local and weightbearing muscles is likely to reverse impairments in the non-weightbearing muscles;

• Initially use specific facilitation techniques for the dysfunctional weightbearing muscles, with emphasis on increasing weightbearing load cues;
• Use optimal weightbearing postures to re-establish recruitement of both the local and weightbearing muscles;
• Weightbearing muscles should be trained under the stretch from gravity in flexed and more upright postures;
• Use static weightbearing postures with increasing holds and/or very slow and controlled weightbearing exercise to enhance the feedback mechanisms;
• Increase gravitational load cues gradually, ensuring local and weightbearing muscles are responding to the increases in load;
• At a later stage it may be necessary to add in specific muscle-lengthening techniques for non-weightbearing muscles, especially if the muscle tightness is in the passive rather than the active elements of the muscle[44].

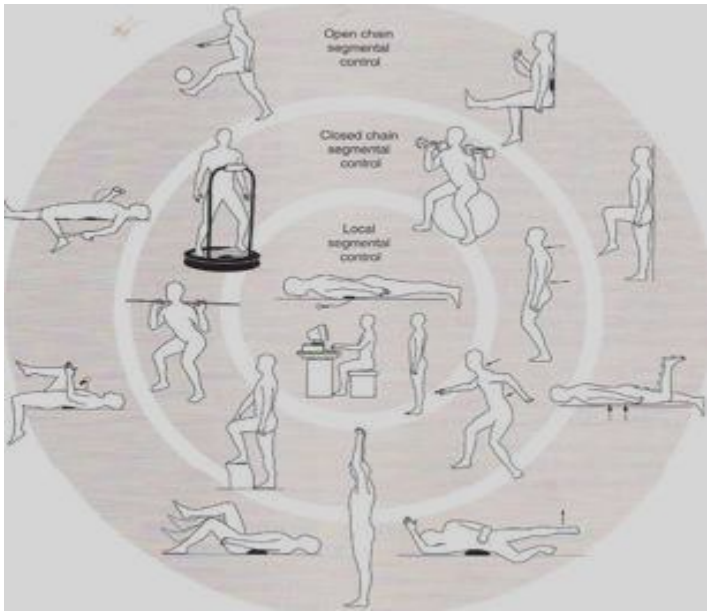
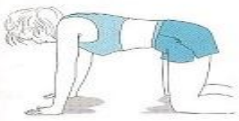


Figure. 4: The segmental stabilization model for the prevention and treatment of low back pain[45].

1.8. EXERCISE TECHNIQUES

The patient must be placed in an initial position lying on the back with the hips and knees flexed. The feet remain flat on the floor and the arms must be held alongside the body. The stabilizer is positioned under the low back and there it measures the movements of the spine. During exercises the spine cannot make any movements. The transversus abdominis muscle must be in contraction while doing exercises and this muscle keeps the spine in the right position. On the picture below the woman is holding the feedback machine. There we can see when her spine moves[48,49].

Starting position	Advantage	Disadvantage
Four-point kneeling 	Abdominal wall is stretched to facilitate abdominal hollowing. Different motor pattern to familiar sit-up exercise protocol in sport Position is comfortable for clients with LBP and during pregnancy. Belt or waistband can be used for tactile cueing.	Position places stress on wrists and knees. Position is difficult for obese clients.
Prone lying 	Whole body is supported. Position makes it easier to avoid spinal movement. Tactile cue is provided when client pulls abdominal wall away from table. Pressure biofeedback may be used.	Position is inappropriate for obese or pregnant client because of soft tissue contact. Position may be challenging for client with breathing difficulties.
Sitting 	Position is useful for daily practice at work. Self-palpation is easily applied. Position rehearses good sitting posture.	Sitting position may exacerbate back pain.
Standing 	Tactile cue is provided to pull abdominal wall away from waistband. Position is appropriate for obese clients. Wall support may be used to reduce spinal movement. Position is functional for daily activities.	Weight bearing may not be suitable for client with discal pathology. Clients with extreme postural abnormalities may find position uncomfortable.

LBP = low back pain.

Table.2 , Fig 05 Abdominal hollowing starting position[46]

1.8a. CONTRACTION OF TRANSVERSE ABDOMINAL MUSCLE

Goal: Learns to contract the transversus abdominis muscle without contraction of the overlying abdominal muscles.

The person pulls his belly in and up at the navel without moving the rib cage, the pelvis or the spine.

Contraction intensity: 30 to 40% of the maximum voluntary contraction.

1) Start with a small contraction.

2)Build up the duration of the contraction.

Only when the patient can control contraction of the transversus abdominis muscle with minimal muscle intensity (10 repetitions each 30-40%) over a period of time , the progress should lead to more advanced exercises.

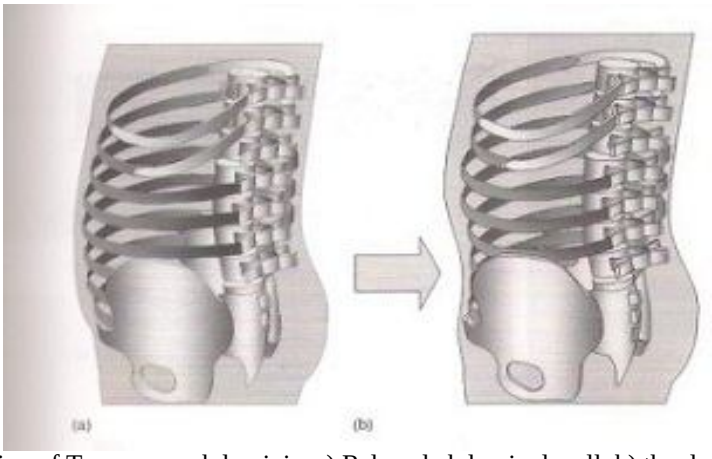


Figure. 6: The action of Transverse abdominis. a) Relaxed abdominal wall, b) the drawn in abdominal wall.[49]

Normally the transversus abdominis muscle is in contraction always while standing and sitting. Contraction of this muscle creates a good posture. In normal conditions the transversus abdominis muscle contract by itself, but in patients with low back pain the muscle doesn't happen naturally. This can lead to an unstable core, which is a risk factor for low back pain. The goal is that patients with low back pain learn to contract the transversus abdominis muscle in all times (except in lying position).

After a time the muscle shut contract naturally. It is very important in patients with low back

pain that they have a good posture, that's why they have to learn to contract the transversus abdominis muscle[49].

1.8b. CONTRACTION OF MULTIFIDUS MUSCLE

The muscle is the most important stabilizer of the spinal extensor group. People with low back pain often lose the ability to contract this muscle and they do not regain the ability spontaneously.
How to do?
First the person learn to recognize what is feels like to tense and relax the muscle.
Second focus not only on the multifidus but also on the lateral abdominals.

1.8b.1. Prone lying Multifidus contraction



Figure.7: Multifidus Contraction in prone lying position[49]

Goal: Teach clients to learn to use the multifidus at will and separately from other muscles. The multifidus is the most important stabilizer of the spinal extensor group. People with low back pain often lose the ability to contract this muscle and do not regain the ability spontaneously.

Prone-lying position

Therapist palplates the multifidus.

Bulge the muscles beneath the fingers of the therapist and differentiate between erector spinae contraction(more lateral) and multifidus contraction(more central).

To differentiate between the multifidus muscle and the erector spinae muscle, it's recommended to contract the erector spinae muslce by hyperextend the trunk. To contract only the multifidus muscle, the patient may not hyperextend the trunk.

1.8b.2. Sitting Multifidus contraction


Figure.8: Multifidus contraction in sitting position[49]

Goal: Encourage your client to contract the multifidus and lateral abdominals simultaneously.
Client sit on the edge of a bench with his feet on the floor.
Lumbar spine in neutral position.
Therapist palpates the multifidus.
Client performs abdominal hollowing
If the therapist feels the contraction, the client can self-palpate and continue the action for 10 repetitions, aiming to hold each for 10 s while breathing normally.

1.8.3. Forward stride(walk) standing multifidus contraction

Goal: Encourage your client to contract the multifidus and lateral abdominals simultaneously.
Stand with one foot in front of the other
Self-palpate the L4-L5 level by placing the thumbs on the lower lumbal spinosus process and moving them outward slightly into the spinal tissue.
Place the weight onto the front leg and then onto the back leg alternately.
Feel the muscles beneath the thumbs switching on and off[49.]

1.9. CONTROLL OF PELVIC MUSCLES

This is important to move confidently into a neutral lumbar position. People with low back pain have not the ability to perform pelvic tilting. You can see excessive flexion laxity but limited, or bloked extension.

The ability to dissociate lumbar movement form pelvic movement is therefore important, and correction of faulty lumbar-pelvic rhythm is vital.

1.10. DIAPHRAGM

The muscles are also reduced in asociation with rapid limb movement and support surface translation while global muscle activity is increased. It may be predicted that people with respiratory disease may have increased incidence of low back pain.

1.11. PRONE KNEELING LUMBER-PELVIC RHYTHM:

Goal: Facilitate active pelvic tilt.
Prone kneeling with shoulders directly above the hands and hip above the knees
Phase 1(a): no lumbar or pelvic movement should occur
Phase 2(b):posterior pelvic tilt and hip flexion occur
Phase 3(c) :Lumbar flexion and some thoracic flexion finish the action
(d): Faulty lumbar-pelvic rhythm often shows up when lumbar flexion and posterior pelvic tilt occur immediately.
Building:
1) The patient learns the tilting
2) The tilting has to be rhythmic.
The control of the pelvic muscles is important to move confidently into a neutral lumbar position. People with low back pain don’t have the ability to perform pelvic tilting. They exhibit also a limited excessive flexion laxity or blocked extension.
The ability to dissociate lumbar movement from pelvic movement is therefore important and the correction of faulty lumbar-pelvic rhythm is vital.

1.12. HIGH (Two-Point) KNEELING (Assisted) HIP HINGE ACTION

Goal: Use a pelvic tilt action to move the spine forward and backward.
Once you can perform pelvic tilting well, you should combine it with classic hip in a hinge action where the trunk moves on the hip in a hinge action and the spine remains straight.
Avoid any increase or decrease in lumbar lordosis!
Draw the abdominal muscles and maintain this minimal contraction throughout the movement!

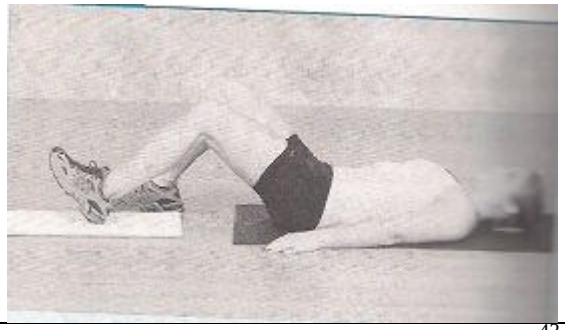
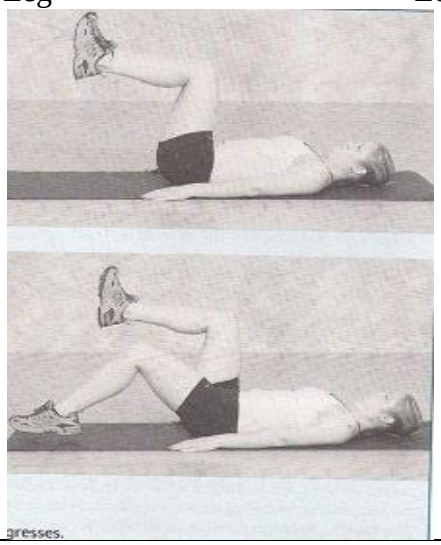
1.13. SITTING PELVIC TILT USING GYM BALL

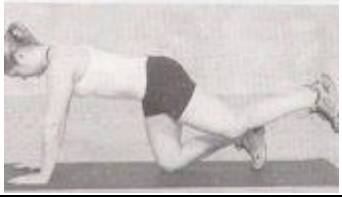
Goal: Teachanterior-posterior pelvic tilt control.
Sit on the ball with knees apart and feet flat on the floor. Both hips and knees should be flexed to about 90°.
Tilt pelvis alternately in both anterior and posterior directions, making sure the shoulders and thoracic spine remain inactive.
Start with small ranges of movement.
Gradually work up to larger ranges.

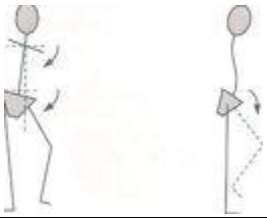
1.14. PROGRESSING STABILITY TRAINING

1.14a. Progressing Stability Training:

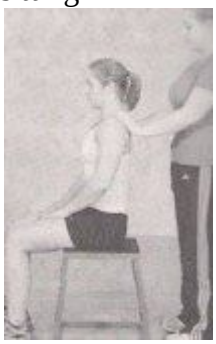
Table 3: Stability Training Exercises

Heel Slide – Basic Movement[43] 	Goal: Place minimal but progressive limb loading on the trunk. Slowly straighten one leg with the heel resting on the ground. The moment the pelvis anteriorly tilts and the lordosis increases, you must stop the movement and draw the leg back into flexion. [43]
Leg Lowering[43] 	This exercise is described in core stability. 'Leg extensions'[43]
Prone-Lying Gluteal Brace[43] 	Goal: co-contract trunk stabilizers with gluteals. Patient has to lie down and dorsiflex the toes. Flex than the knees (10°) and the hip (10°). After that contract the gluteal muscles.[43]
Bridge from Crook Lying (Shoulder Bridge)[43] 	'Dynamic leg and back'[43]
Bridge with leg lift[43]	Goal: progress from bridge from crook lying. The patient starts in crook lying ,then he lifts one leg.

	Avoid : allow the pelvis to fall toward the unsupported side! [43]
Four-point Kneeling Leg movement[43]  	'Hamstrings raising'.[43]
Four- point Kneeling arm and leg lift (full bridge)[43] 	'Bird dog'[43]
Side-Lying spine lengthening[43] 	Goal: control the quadratus lumborum and lateral fibers of the oblique abdominals. Start position: strong co-contraction of the abdominal muscles. Lie on one side, thighs in line with your body and flex the knees 90°. Upper body supported on the same side elbow. Straighten your spine against the force of gravity, leaving the body supported on the forearm of the underneath arm and hip. [43]
Side-lying hip lift[43] 	'Oblique abdominals'[43]
Side-lying body lift(Side bridge)[43] 	Goal: progress from side-lying spine lengthening. Start position: side-lying spine lengthening. Lift the hips, leaving the body supported on the forearm of the underneath arm and the knees only.[43]

Pelvic shift with leg lift[43] 	Goal: teach pelvic control and stability in single-leg standing. Shift the pelvis to the left, lift slowly the right leg. The supporting leg supports the pelvis and the pelvis supports the back. Raise the knee no more than 45°.[43]
Sitting knee raise[43] 	Goal: maintain pelvic positon against the pull of the hip flexors. Raise one knee, about 8 cm. Unload the limb by lifting the heel. If he is able to maintain good alignment, have him lift the entire leg. Avoid: posterior pelvic tilt! [43]

1.14b.Unstable Base

Rapid Displacement in sitting[43] 	Goal: Develop muscle reaction speed for back stability. The patient sit on a chair with her spine optimally aligned. A partner stands behind the person and press on the shoulders in multiple directions; flex, extend and laterally flex the spine. The patient needs to be able to rapidly stabilize his spine. That patient needs to relax the trunck muscles between repetitions.[43]
Throwing and catching on a mobile surface[43] 	Goal: develop rapid-onset back stability. Throwing and catching a bal on a mobil surface while you try to stabilize it.The aim is to align the lumbar spine optimally.[43]
Neutral position maintenance[43]	Goal: build stability reaction speed in sitting. The patient has to try to balance his body while a person knock the patient. The patient sits in a neutral position on a wobble board. Work gradually up the pressure. [43]

1.15. STABILITY EXERCISE FOR SUPERFICIAL MUSCLES

It is important for practitioners/sports personnel attempting to global/superficial muscle function and strength to have a clear understanding of any pathoanatomical problems that may be positively or negatively affected by such exercise. Ideally all of these exercises should be done with correct lumbo-pelvic posture and control of the local/deep muscles. With most of these exercises duration of hold and repetitions can be varied (depending on the aim of the retraining/strength program) provided the exercise is done with good control.

1. Crunches- Lie supine on the floor with your knees bent, arms crossed over your chest and the feet flat on the floor. Then lift your schoulders from the ground and curl you stomach. Avoid a full sit up and ensure the low back remains in contact with the floor.
2. Obliques crunches - As per a normal crunch but leading with one shoulder towards the opposite knee (alternate sides each repetition).
3. Plank - Lie prone on the floor. Then while keeping your whole trunk straight (like a plank) lift up onto your forarms, with the elbows right under the shoulders, and toes. Hold this position as long as possible with control. To make the exercise more difficult try to lift one leg slightly of the ground. Balls/balance devices can also be used under the arms or feet. The plank can also be done on your side while supported by your feet and your forearm with your shoulder above your elbow.
4. Bridges - Lie supine with your knees bent and the feet flat on the floor. Lift your pelvis of the ground while supporting on your feet and shoulders. The bridge can be progressed by lifting one foot off the ground end extending the knee.
5. Hamstring raises - Balance on you hands and knees with your back flat and your arms/thighs perpendicular to the floor. Raise one leg behind you until it is horizontal. Alternate.
6. Superman – As per a hamstring raise but progress by lifting the opposite arm to a horizontal position at the same time. Alternate.

7. Leg raises - Lie on your back with your legs straight and your arms by your sides. Then lift one leg 4 inches of the ground. Your back has to stay flat on the floor. Don't allow it to arch. Alternate. The exercise can be progressed by lifting both legs at the same time
8. Hundreds - Lie on your back with your legs straight and your arms by your sides. Then lift both legs so that they form a right angle in the hip and knees. Lift your arm straight a few inches off the ground. Then simpli tap the ground 100 times. Focus on keeping your hips and legs completely still and your back flat.

Leg extensions - Lie on your back with your legs straight and your arms by your sides. Then keeping the knee straight lift one leg until the foot is 4 inches off the ground. Alternate[50]

1.16. LOWER EXTREMITY MUSCLES EXERCISES

It is possible that lumbar instability is not only limited to the lumbar spine and the anatomical structures complementing it. Sacro-iliac joint instability for instance plays also a part and can be the cause of low back pain. Studies have found that a big contributor to this sacro-iliac joint instability and low back pain is the malrecruitment of the m. gluteus maximus and m. biceps femoris.

The patient has to perform a few slow hip extensions. The physiotherapist places one hand on the M. gluteus maximus of the patient and one on the hamstring muscles. The therapist gives feedback with his hand. The patient has to activate his gluteus maximus first and if he does this correctly he pushes the hand on his gluteus maximus muscles away first, before he does the same with his hamstring muscles.

It has been showed that there is a relationship, especially in muscle coordination, between the muscles that stabilize the lumbar spine and the muscles in the lower extremity, so these muscles has to be trained too, to further achieve coordinated activity between all muscles within a balanced muscular system.The quadriceps muscles play a part in this relationship also. A study has found that patients with low back pain have deteriorating function of the quadriceps muscles. Endurance and feedforward in the patients quadriceps muscles tend to be weak. The study found

that this is due to reduced quadriceps activation after localized lumbar paraspinal fatiguing isometric exercise . Exercises aimed at localized fatigue of the lumbar spine extensors have shown an immediate response in the lower extremity including reduced quadriceps central activation ratio deteriorated balance and response to a balance perturbation. Furthermore they describe a quadriceps fatigability during maximal effort isokinetic knee extension contractions.The two main functions of the quadriceps are extension of the knee and flexion of the hip.



Figure.9: Straight Leg Raising in sitting position

The patient starts with both his feet on the ground. The patient then straightens one leg and holds this position for about 10 seconds. Then the patient switches legs. To make this exercise a loaded exercise, the patient can do this exercise with weights(for instance on a leg extension machine). Ask the patient to hold for 1-3 seconds[51].

1.1. LITERATURE REVIEW

1. Javed S et al.[52] did the study the influence of work frequency of work related low back pain among physical therapist those who working at least 3 month or more the questionnaire includes following question about BMI, physical activity level and sub specialty area and shows that those therapist who were occupied in general physical therapy had high percentage of work related low back pain. This research concludes that work related low back pain is more common in female therapist than male and in newly graduate physical therapist in general physical therapy.

2. Kimberely M et al[53]. did the study to influence on conservative treatment of spondylosis as this disease has complicated diagnosis. According to them there is no current concrete, gold standard treatment approach to the diverse range of patient presented despite they include all conservative treatment option includes exercise therapy, lumbar support, traction, transcutaneous electrical nerve stimulation , spinal manipulation and pharmacotherapy. Their efforts no doubt fine tunes and present means to tackle not only symptoms, but confront progression and ultimately prevention of disease in year to come.

3. J M Firtz et al[54]. did the study to influence on accuracy of the clinical examination to predict radiographic instability of the lumbar spine. This study examined a prospective cohort of patients referred for flexion-extension radiographs based on suspicion of instability. According to them patients underwent both a radiologic and clinical examination. The clinical factors could be used to inform treatment decision-making without a sole reliance on radiographic assessment.

4. Lee JS et al[55.] did the study was to examine the effects of selective exercise for the deep abdominal muscles (SEDA) and lumbar stabilization exercise (LSE) on the thickness of the transversus abdominis and postural maintenance on an unstable base of support. The thickness of the transversus abdominis was measured using ultrasound imaging during rest and drawing-in. The thickness of the transversus abdominis was measured when subjects raised their right and left legs while lying on a Swiss ball. They conclude that both SEDA and LSE thickened the transverus abdominis, which is a deep abdominal muscle, thereby adjusting posture, and stabilizing the trunk. These exercises increased the thickness of the deep abdominal muscles.

5. Lee SW et al[56.] did the study by compare difference in hip range of motion between a lumbar stability group and a lumbar instability group of patients with chronic low-back pain. The patients were assessed using a goniometry to evaluate the hip range of motion. The result of the study indicates that the limitation of hip range of motion of the lumbar instability group was significantly greater than that of the lumbar stability group. They conclude that the chronic low-back pain patients showed greater limitation of hip range of motion than healthy persons, and among them, those who had lumbar instability showed greater limitation than those with lumbar stability.

6. Senthal et al[57.] did the cross over study about efficacy of segmental stabilization exercise compare with placebo treatment in lumbar instability. Testing instrument includes visual analog scale for assessing the intensity of perceived pain and scale which is put forth by Stanley Paris which was found to be reliable and valid tool for joints assessment. The scale had seven items 0-6: 0, Ankylosed; 1, Considerable hypomobility; 2, Mild hypomobility; 3, Normal mobility; 4, Mild hypermobility; 5, Considerable hypermobility; and 6, Unstable. Segmental stabilization exercise therapy was more effective than placebo intervention in symptomatic lumbar segmental instability amongst people with mechanical low back pain.

7. Benjamin E Smith et al[58.] Did the study about systemic review or update of stabilizing exercise for low back pain. Pain and disability scores were transformed to a 0 to 100 scale. Meta-analysis showed significant benefit for stabilization exercises versus any alternative treatment or control for long term pain and disability. The objective of this systematic review was to evaluate the current evidence for the benefit of stabilization (or 'core stability') exercises for low back pain. The overall results of the meta-analysis indicates a trend favoring core stability exercises which is not regarded as clinically significant, when compared with any alternative treatment or control.

8. Iguchi et al[59]. Did the study to investigate the proportion and relationship of three individual radiological factors with age on segmental instability and in sagittal plane in consecutive age group. Inclusion criteria is the excessive angulations and translation in 880 out patients(389 men, 491women) with low back pain aged from 14 to 84 years was investigate by 3 observer. The presence of patient with excessive angulations and translation in younger age group suggest they

have a hyper mobility segment with least degenerated discs. Different predominant pattern of this radiologic factor may reveal the probable aging process of the instability.

9. Odole A.C., Adegoke B.O.A. et al (2010)[60.] find out the "the Knowledge and Attitude of Sectional Heads towards managing Low Back Pain (LBP) at work at the University College Hospital, Ibadan". There were twenty-nine sectional (16 male and 13 female) heads at the University Teaching Hospital participated in this cross-sectional survey. The results shows that Twenty-six (89.7%) of the participants reported no difficulty in managing staff members with low back pain. Seventeen (58.6%) participants had poor knowledge, while 37.9% had fair to good knowledge of managing LBP at work. It is concluded that Sectional heads at the University College Hospital, Ibadan have poor knowledge but a positive attitude towards managing workers with LBP.

10. A study comparing the effects of specific stabilization exercises with those of manual treatment in patients with sub acute or chronic LBP was conducted by E Rasmussen et al[61]. It was concluded that stabilizing training seemed to be more effective than manual therapy in terms of improvement of individuals and the reduced need for recurrent treatment periods.

11. An RCT of combined manipulation, stabilizing exercises and physician consultation compared to physician consultation alone for chronic LBP was conducted by Niemisto et al[62]. It was concluded that manual therapy with stabilizing exercises was more effective in reducing pain and disability than physician consultation alone .This study showed that short, specific treatment programs with proper patient information may alter the course of chronic LBP.

12. An RCT investigating the efficiency of musculoskeletal physiotherapy on chronic low back disorder was conducted by Lucy Jane Goldby[63]. In this study, the patients were enrolled in a 10 week program of specific spinal stabilization exercises. The results indicated statistically significant improvements in favor of the spinal stabilization group at 6 month stage in pain and dysfunction and at the one year stage in medication, dysfunction and disability.

13. A systematic review of RCT's was conducted by Berid et al[64.] To evaluate the effectiveness of segmental stabilization exercises for acute, sub acute and chronic LBP with regard to pain, recurrence of pain, disability and return to work 7 trials were included in the review. For acute LBP, SSE were equally effective in reducing short term disability and pain and more effective in

reducing long term recurrence of LBP than treatment by GP. For chronic LBP, SSE were in the short and long term more effective than GP treatment and may be as effective as other PT treatment in reducing disability and pain. There was limited evidence that SSE additional to other PT treatment are equally effective for pain and more effective concerning disability than other PT treatment alone. There was no evidence concerning subacute LBP.

14. A study investigating whether four weeks of training of repeated voluntary TrA contractions could induce long-term changes in control of the trunk muscles was conducted by H. Tsao and P. Hodges[65]. The results suggest that four weeks specific motor control training is associated with consistent changes in motor control of the trained muscle during functional tasks.

15. Low back pain (or lumbago) is a common musculoskeletal disorders affecting 80% of people at some point in their life. It accounts for more sick leave and disability than any other medical condition [Ferreira DM, Zangaro RA, Villaverde AB, Cury Y, Frigo L, Piccolo G, Longo I, Barbosa DG (2005)][66]. Lumbago can be either acute, subacute or chronic in duration. Most often, the symptoms of low back pain show significant improvement within a few weeks from onset with conservative measures.

1.2. OBJECTIVE:

To determine the specific exercise intervention in the treatment of patients with lumbar instability and a radiologic diagnosis of spondylosis or spondylolisthesis.

1.3 HYPOTHESIS:

A recent focus in the physiotherapy management of patient with back pain going for training of specific training of muscle surrounding the spine (deep abdominal muscle and lumbar multifidus) consider to provide dynamic stability amd fine control to the lumbar spine. The spinal stability is depend on an interplay between, the passive, active and neutral control system. Accordingly, where the stability of the basic morphology of the lumbar spine is compromise (such as with symptomatic spondylosis and spondylolisthesis). The purpose of this study is specific training of the muscles to provide dynamic stability to the lumbar spine which may act to maintain the neutral zone of the motion segment within more normal limit during functional activity.

CHAPTER # 2

2.0. METHODOLOGY

2.1. METHOD:

The aim of the current study was to evaluate the effectiveness of specific "stabilizing" exercises in the treatment of patients with CLBP whose symptoms were considered attributable, based on radiologic diagnosis, to spondylosis or spondylolisthesis. These exercises were directed primarily at the deep abdominal muscles, with co-activation of the LM proximal to the pars defect.

Patients Criteria for Inclusion: in the study was restricted to 50 patients of either gender between the ages of 20 to 80 whose LBP symptoms (with or without pain extension into the lower limbs). The patients were selected on the basis of their symptoms and clinical presentation being considered attributable to the radiologic diagnosis of spondylosis or spondylolisthesis by their treating medical specialist. The radiologic diagnosis of spondylosis or spondylolisthesis was determined by a consultant radiologist after oblique and lateral view radiographs or reverse-gantry-view computed tomography scanning of the lumbar spine.

Patients Criteria for Exclusion: from entry to the trial if they had: a clinical presentation considered not attributable to the presence of the spondylosis or spondylolisthesis by the treating medical specialist; a diagnosed psychologic illness; difficulty understanding English, precluding them from answering the questionnaires; undergone spinal surgery; or a diagnosed inflammatory joint disease or displayed overt neurologic signs (sensory or motor paralysis). Patients were withdrawn from the study if they withdrew their consent, showed a lack of cooperation and motivation to carry out the intervention (indicated by less than 50% compliance as measured by the patient compliance form), or showed any persistent exacerbation of their symptoms. Patients were recruited from general and specialist medical practices, pain management clinics, and physiotherapy practices in the Perth metropolitan area.

2.2. STUDY DESIGN:

A randomized, controlled clinical trial, test-retest design with two treatment groups and a blind investigator was used. At entry to the trial, patients signed an informed consent form and then undertook the testing procedure (described later), performed by an independent investigator blind

to group allocation. After completion of the initial testing, the patients were assigned randomly to either the specific exercise group (SEG).

2.3. MEASURES:

Before measures were carried out, each patient's height and weight was assessed and a brief history was taken, noting age, mode of onset of symptoms, duration of symptoms, and treatment history. All measures used were validated previously and shown to have acceptable reliability. These were:

2.3a.Pain Measures:

The short form McGill pain questionnaire was used. This questionnaire includes: (a) a visual analogue pain scale, (b) a pain body chart.

2.3b. Functional Measures:

The Oswestry disability questionnaire was used to give a percentage score that indicated each patient's level of functional disability. This questionnaire is used widely to monitor treatment affect with regard to changes in the functional mobility of patients with CLBP and is sufficiently sensitive to monitor these changes[67].

2.4. INTERVENTION:

The treatment approach given was standardized such that all therapists followed the guidelines as follows:

The intervention involved patients being taught exercises designed to:

1. Train the specific contraction of the deep abdominal muscles, without substitution from large torque producing muscles such as rectus abdominis and external oblique, using the abdominal drawing in maneuver.
2. Train the specific contraction of deep abdominal muscles with co-activation of LM proximal to the pars defect.

The holding time for these exercises was increased gradually, in conjunction with a pressure biofeedback monitor, to the point where patients were able to perform 10 contractions with 10-second holds. It was stressed that these exercises are precise isometric contractions involving low levels of maximum voluntary contraction, to ensure that subtle patterns of muscular substitution

were prevented. Once an accurate and sustained contraction of these muscles was achieved, the exercises were progressed by applying low load on the muscles by means of adding leverage through the limbs. Subjects were required to perform the exercises at home on a daily basis. The exercise program was designed to take approximately 10-15 minutes[68].

Once accurate activation of the co-contraction patterns (1 and 2) was achieved without synergistic substitution, they were incorporated immediately into functional holding postures and activities known to previously aggravate the subjects symptoms. Subjects were encouraged to activate these muscles regularly during daily activities, particularly in situations where they anticipated or experienced pain or felt unstable. This aimed to enhance the dynamic stability of the lumbar spine in a functionally specific manner for each individual. In a practical sense, if the subject complained of the onset of symptoms in sustained positions such as sitting and standing, they were trained to perform a gentle sustained co-contraction in these positions throughout the day. If, however, the complaint was an arc of pain during lumbar flexion, co-contraction was initiated during this movement pattern. The same was the case for twisting of the spine and extension activities. Once appropriate activation was trained during dynamic movement tasks, this pattern was incorporated into light aerobic activity such as walking and previously aggravating activities of daily living, at the speed the activity demanded.

CHAPTER # 3

RESULT

Data was stored and analyzed using SPSS 16.0, mean and standard deviations were reported for the variables quantitative in nature, like age, Pre and Post pain scores at VAS and MODI scale, count with percentages were given for the gender and age groups.

To compare the mean differences of pain scores at pre and post level a paired sample t-test was used and the results with p-value less than 0.05 were considered as significant, VAS and MODI pain scores at pre and post level were also tested after taking the confounding effect of age groups and gender using paired sample test, Bar charts also used to display the graphical representation of mean scores and other basic characteristics of data.

Table 4: Basic Information about patients Age groups and Gender.

Characteristics		**n**	**%**
Age group (years)	**20-50**	27	54
	51-80	23	46
Age in years	**(Mean ,SD)**	48.22	9.20
Gender	**MALE**	22	44
	FEMALE	28	56

Table 4 showed that in the present study there were 50 patients examined, 54% (27) were of age group 20 – 50 years old, 56% (28) were females, the mean age and standard deviation of the data was 48.22 ± 9.20.

Graph 1 gives the graphical representation of the results given in table 1 using bar chart diagram.

Graph 1: Basic Information about patients Age group and Gender.

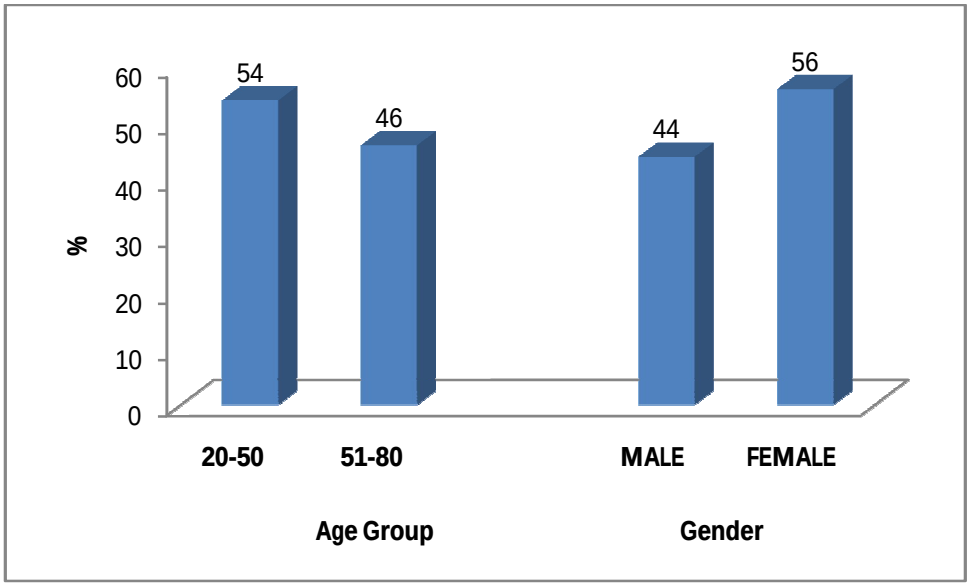


Table 5: Mean Comparison of Pain Scores Using VAS Scale (n=50)

VAS	Mean	Standard Deviation	Mean Difference	p-value	Decision
Pre	7.84	0.95	5.42	<0.01*	Reject Null Hypothesis
Post	7.84	0.83			
*p< 0.05 considered significant using paired sample t-test					

Table 5 gives the mean and standard deviation of pain scores using VAS scale at pre and post stage. It was found that at pre stage pain was 7.84 ± 0.95 and after the treatment, at post level it was 2.42 ± 0.83, from pre to post level mean pain score significantly get down, p value was found less than 0.01 using paired sample t-test which concludes that the mean pain score at pre and post stages were not same.

Bar chart 2 presents the mean at pre and post stages using VAS scale.

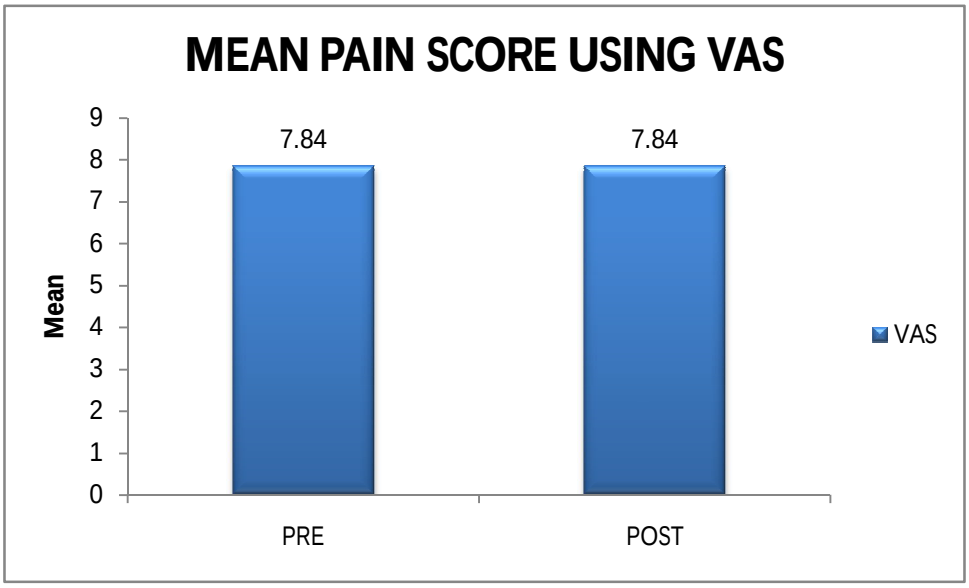


Table6: Mean Comparison of Pain Scores Using MODI Scale (n=50)

MODI	Mean	Standard Deviation	Mean Difference	p-value	Decision
Pre	71.52	11.59	50.56	<0.01*	Reject Null Hypothesis
Post	20.96	4.52			
*p< 0.05 considered significant using paired sample t-test					

Table 6 gives the mean and standard deviation of pain scores using MODI scale at pre and post stage. It was found that at pre stage pain was 71.52 ± 11.59 and after the treatment, at post level it was 20.42 ± 4.52, from pre to post level mean pain score significantly get down about 50.56 point, p value was found less than 0.01 using paired sample t-test that showed that mean pain score in MODI scale were not same.

Bar chart 3 presents the mean at pre and post stages using MODI scale.

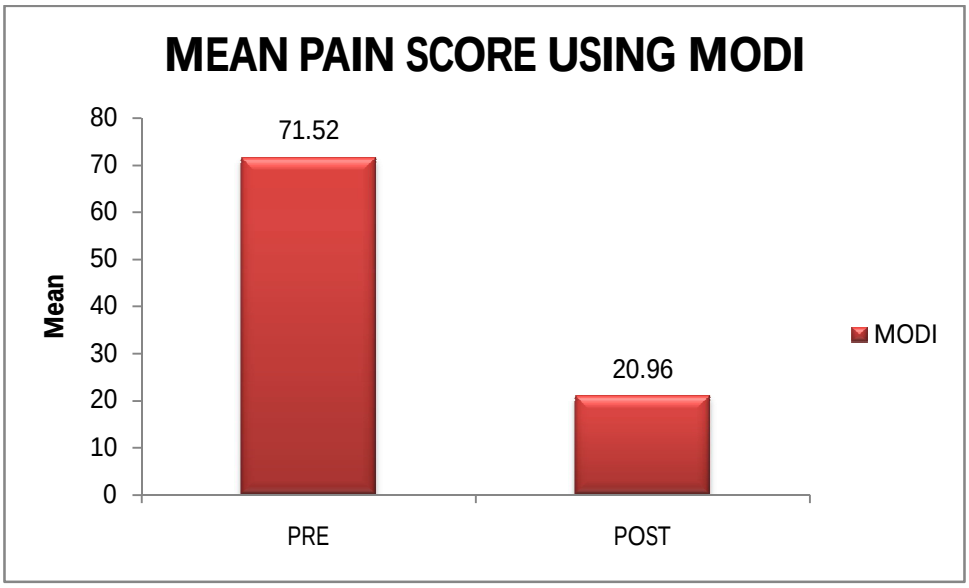


Table 7: Mean Comparison of Pain Scores Using VAS Scale with Age Group

Age Group	VAS	Mean	Standard Deviation	Mean Difference	p-value	Decision
20 – 50 years n=27	**Pre**	7.70	1.10	5.44	<0.01*	Reject Null Hypothesis
	Post	2.26	0.76			
51 – 80 Years n=23	**Pre**	8.0	0.73	5.39	<0.01*	Reject Null Hypothesis
	Post	2.61	0.89			
*p< 0.05 considered significant using paired sample t-test						

Table 7 gives the mean and standard deviation of pain scores using VAS scale at pre and post stage after taking the effect of Age into two separate groups , It was found that at in the patients with age group 20 – 50 years old , pre stage pain was 7.70 ± 1.10 and after the treatment, at post level it was 2.26 ± 0.76, from pre to post level mean pain score significantly get down about 5.44

point, p value was found less than 0.01 using paired sample t-test, similarly in the age group 51 – 80 years old mean pain score at pre stage was 8.0 ± 0.73 and at post stage it was 2.61 ± 0.89 , it also gives significantly mean differences with p-value less than 0.01 obtained using paired sample t-test.

Bar chart 4 presents the mean at pre and post stages using VAS scale with respect to each age group.

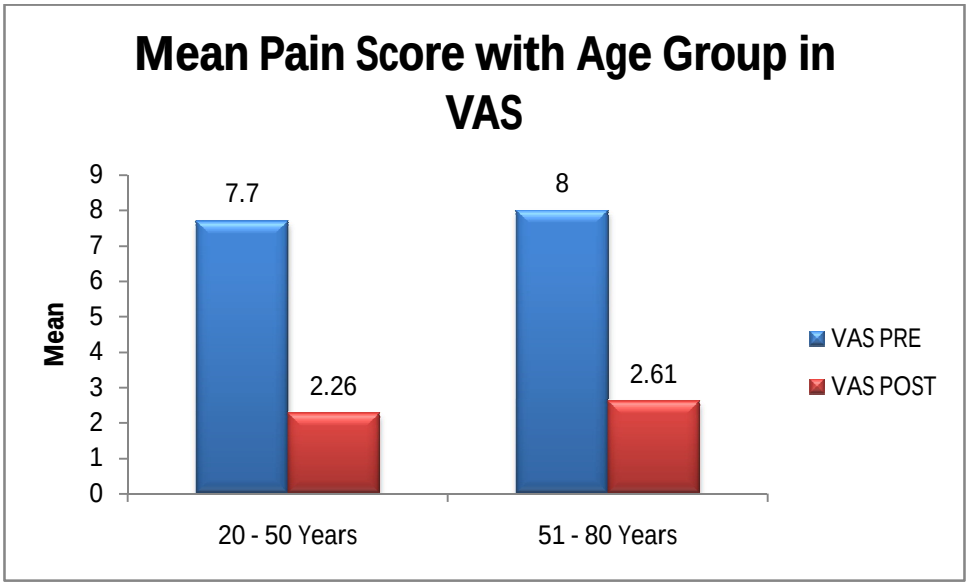


Table 8: Mean Comparison of Pain Scores Using VAS Scale with Gender

Gender	VAS	Mean	Standard Deviation	Mean Difference	p-value	Decision
Male n=22	**Pre**	7.82	1.09	5.18	<0.01*	Reject Null Hypothesis
	Post	2.64	0.79			
Female n=28	**Pre**	7.86	0.84	5.60	<0.01*	Reject Null Hypothesis
	Post	2.25	0.84			
*p< 0.05 considered significant using paired sample t-test						

Table 8 gives the mean and standard deviation of pain scores using VAS scale at pre and post stage after taking the effect of gender , It was found that in the Male patients at pre stage pain was 7.82 ± 1.09 and after the treatment, at post level it was 2.64 ± 0.79, from pre to post level mean pain score significantly get down about 5.18 point, p value was found less than 0.01 using paired sample t-test, similarly in the female patients mean pain score at pre stage was 7.86 ± 0.84 and at post stage it was 2.25 ± 0.84 , it also gives significantly mean differences with p-value less than 0.01 obtained using paired sample t-test.

Bar chart 5 presents the mean at pre and post stages using VAS scale with respect to Gender.

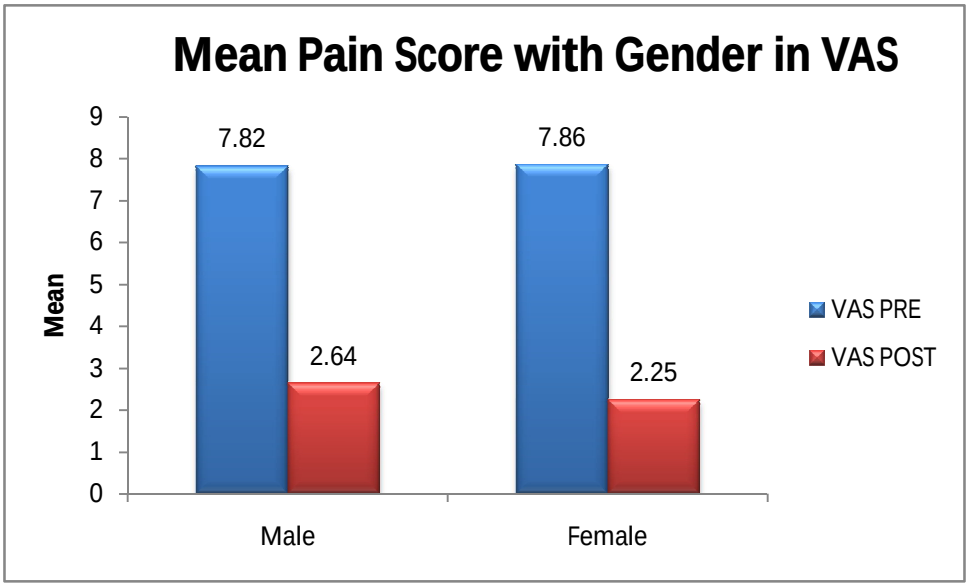


Table 9: Mean Comparison of Pain Scores Using MODI Scale with Age Group

Age Group	MODI	Mean	Standard Deviation	Mean Difference	p-value	Decision
20 – 50 years n=27	**Pre**	69.93	12.57	49.03	<0.01*	Reject Null Hypothesis
	Post	20.89	4.87			
51 – 80 Years n=23	**Pre**	73.39	10.29	52.34	<0.01*	Reject Null Hypothesis
	Post	21.04	4.17			
*p< 0.05 considered significant using paired sample t-test						

Table 9 gives the mean and standard deviation of pain scores using MODI scale at pre and post stage after taking the effect of Age into two separate groups , It was found that at in the patients with age group 20 – 50 years old , pre stage pain was 69.93 ± 12.57 and after the treatment, at post level it was 20.89 ± 4.87, from pre to post level mean pain score significantly get down about 49.03 point, p value was found less than 0.01 using paired sample t-test, similarly in the age group 51 – 80 years old mean pain score at pre stage was 73.39 ± 10.29 and at post stage it was 21.04 ± 4.17 , it also gives significantly mean differences with p-value less than 0.01 obtained using paired sample t-test.

Bar chart 6 presents the mean at pre and post stages using MODI scale with respect to each age group.

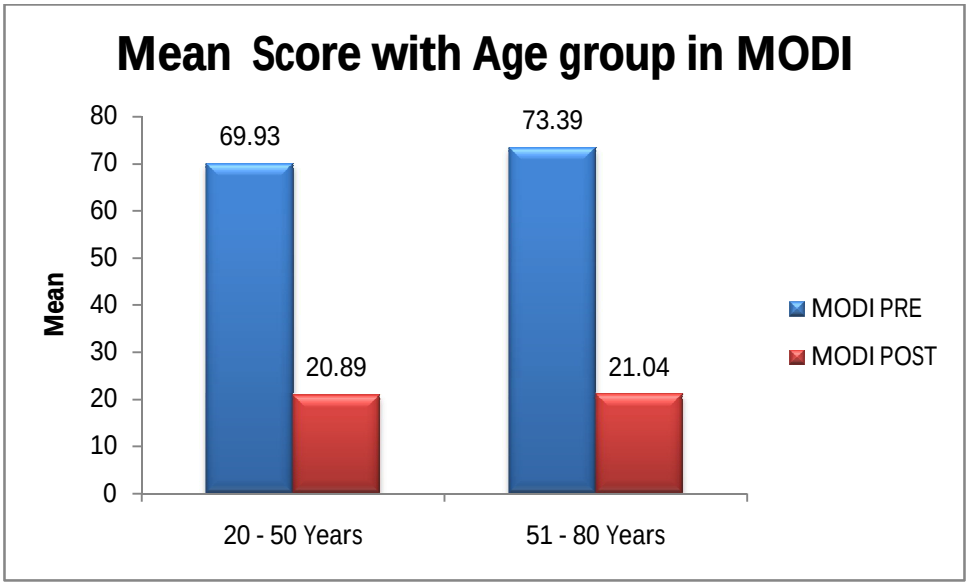
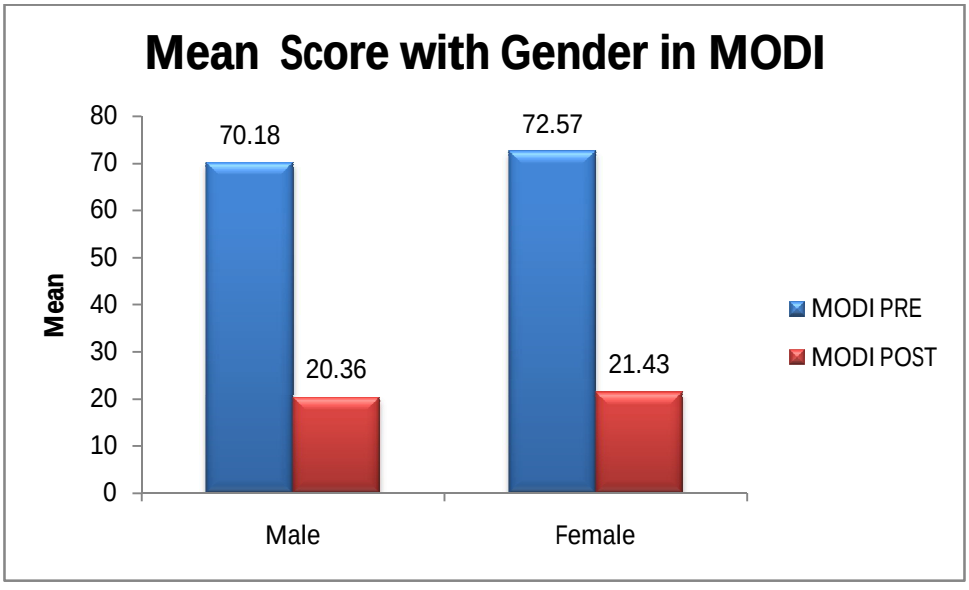


Table 10: Mean Comparison of Pain Scores Using MODI Scale with Gender

Gender	MODI	Mean	Standard Deviation	Mean Difference	p-value	Decision
Male n=22	**Pre**	70.18	12.10	49.81	<0.01*	Reject Null Hypothesis
	Post	20.36	3.36			
Female n=28	**Pre**	72.57	11.28	51.14	<0.01*	Reject Null Hypothesis
	Post	21.43	5.27			
*p< 0.05 considered significant using paired sample t-test						

Table 10 gives the mean and standard deviation of pain scores using MODI scale at pre and post stage after taking the effect of gender , It was found that in the Male patients at pre stage pain was 70.18 ± 12.10 and after the treatment, at post level it was 20.36 ± 3.36, from pre to post level mean pain score significantly get down about 49.81 point, p value was found less than 0.01 using paired sample t-test, similarly in the female patients mean pain score at pre stage was 72.57 ± 11.28 and at post stage it was 21.43 ± 5.27 , it also gives significantly mean differences with p-value less than 0.01 obtained using paired sample t-test.

Bar chart 7 presents the mean at pre and post stages using MODI scale with respect to Gender.



CHAPTER # 4

DISCUSSION

The results of this study support the initial hypothesis that specific exercise training of the "stability"muscles of the trunk is effective in reducing pain and functional disability in patients with chronically symptomatic spondylosis and spondylolisthesis. This treatment approach was more effective than other conservative treatment. These findings support the Panjabi's hypothesis that the stability of the lumbar spine is dependent not solely on the basic morphology of the spine, but also the correct functioning of the neuromuscular system. Therefore, if the basic morphology of the lumbar spine is compromised, as in the case with symptomatic spondylolysis and spondylolisthesis, the neuromuscularsystem may be trained to compensate, to provide dynamic stability to the spine during the demands of daily living[69].

The recent research of Gardner-Morse et al lends support to Panjabi's hypothesis, revealing that reduction of motion segment stiffness of as little as 10% can compromise the stability of the spine. They concluded that factors such as pathologic reduction in motion segment stiffness, as well as poor neuromuscular control of the spinal musculature and reduction of muscle stiffness, could result in a state of spinal instability[70]. Consistent with these findings, Cholewicke and McGill reported that lumbar stability is maintained *in vivo* by increasing the activity (stiffness) of the lumbar segmental muscles, and highlighted the importance of motor control to coordinate muscle recruitment between large trunk muscles and small intrinsic muscles during functional activities, to ensure stability is maintained. The global muscle system consists of large, torque-producing muscles[71], that act on the trunk and spine without being directly attached to it. These muscles include the rectus abdominis, external oblique, and the thoracic part of lumbar iliocostalis, and they provide general trunk stabilization, but they are not capable of having a direct segmental influence on the spine. The local muscle system consists of muscles that directly attach to the lumbar vertebrae and are responsible for providing segmental stability and directly controlling the lumbar segments. By definition, the LM,TA, and posterior fibers of the IO form part of this local muscle system. The TA, IO, and LM are muscles known to be tonically active during upright postures and during active spinal movements with the TA capable of tonic

activity irrespective of trunk position, direction of movement, or loading of the spine[72]. Recent research indicates that the TA is also the first trunk muscle to become activated before movement initiation or perturbation, and is the primary muscle involved in the initiation and maintenance of intra abdominal pressure[73]. The TA and the posterior fibers of the IO also have a direct potential stabilizing role on the lumbar spine by way of their attachment to the lumbar spine through the thoracolumbar fascia. Of the back extensor muscles, the LM is considered to have the greatest potential to provide dynamic control to the motion segment, particularly in its neutral zone[74]. The co-contraction of the deep abdominal muscles with the LM has the potential to provide a dynamic corset for the lumbar spine, enhancing its segmental stability during functional tasks and the maintenance of neutral spinal postures, irrespective of position of the spine[75].

Research investigating changes to the neuromuscular system in the presence of CLBP and lumbar instability indicates that it is the local muscle system that is particularly vulnerable to dysfunction. Several studies have highlighted the presence of specific dysfunction in the LM and, more recently, the deep abdominal muscles in the population with CLBP. Such changes appear to result in altered patterns of synergistic control or coordination between trunk muscles[76]. These findings support those of clinicians who report the presence of altered patterns of motor control between trunk synergists, such that global system muscles have a tendency to substitute or dominate over the impaired function of local system muscles in the population with CLBP[77]. It could be argued that the presence of an "unstable" spondylolysis or spondylolisthesis, coupled with this form of dysfunction in the neuromuscular system, could render the motion segment doubly vulnerable during functional tasks.

The specific exercise approach used in this trial is very different to general exercise approaches commonly advocated in the rehabilitation of patients with CLBP. This approach aims, in the early stages, to specifically train the isometric co-contraction of the deep abdominal muscles and LM proximal to the pars defect, with minimal co-activation of global system muscles. These cocontractions involve a high level of specificity and patient compliance and low levels of maximal voluntary contraction. an isolated pattern of activation of the deepabdominals and co-activation with LM was reported to be very difficult to achieve because of dominant substitution of other trunk synergists such as rectus abdominis, external oblique, the long back extensors, and

difficulty controlling breathing. It was reported that, during the trial, several subjects took as long as 4 or 5 weeks of specific training before an accurate pattern of co-contraction could be achieved. The greater the effort or higher the level of voluntary contraction to the motor task, the more likely the patients were to alter the motor pattern by activating other muscles. Low load was only introduced through the limbs when the patients could isolate the contraction and hold it 10 times for 10 seconds.

Once this pattern of co-contraction was achieved, it was immediately incorporated into dynamic tasks or static holding postures, as determined by the subject's complaint. Subjects were encouraged to perform the contractions many times throughout the day, particularly in situations where they experienced or anticipated pain or felt "unstable." This was deemed essential to reinforce engram motor programming, such that the patterns of co-contraction would eventually occur automatically, without need for conscious control during activities and habitual postures of daily living[78]. Only once was this pattern of muscle co-contraction isolated or did many of the subjects report a reduction in symptoms when able to integrate it into static postures (such as sitting, standing and sustained flexion), functional activities (such as bending, twisting, and lifting), and aerobic activities (such as walking,swimming, or running). This ability to control pain reported by many subjects when performing the muscle co-contraction appeared to act as a powerful biofeedback to reinforce the integration of this muscle control into functional tasks.

The range of spinal motion in both groups remained unchanged after the intervention period. The majority of subjects had full spinal mobility but complained of through-range movement pain, or pain in neutral-sustained postures rather than end-of-range symptoms. In addition, it was commonly reported that, in the exercise group, the addition of the specific muscle co-contraction significantly diminished or abolished symptoms in many subjects during these previously painful movements and postures. It could be argued that these observations lend support to the Panjabi's view that lumbar instability is a condition that influences active neutral zones more than the total range of spinal motion.

The findings of this study support the view that a change in the motor program had occurred in the patients after the intervention, such that the automatic pattern of recruitment of the abdominals to stabilize the spine during a motor task incorporated higher levels of deep abdominal muscle activity. This appears to represent an enhanced ability, in those in the patients, to stabilize dynamically their spine during functional tasks. A challenge for future research will

be to further investigate the potential of this form of exercise intervention to alter automatic patterns of muscle recruitment within the trunk musculature in pain populations. Further research is needed to assess the efficacy of this form of intervention in other CLBP populations where the anatomic stability of the lumbar spine has been compromised[79].

CHAPTER # 5

CONCLUSION:

The findings of this trial support the view that the functional integration of specific exercises directed at the deep abdominals and LM muscles are effective in reducing pain and functional disability in patients with chronically symptomatic spondylosis or spondylolisthesis. The spinal stability is dependent on an inter play between the passive, active, and neural control systems. Accordingly, where the stability of the basic morphology of the lumbar spine is compromised (such as with symptomatic spondylosis or spondylolisthesis), specific training of the muscles considered to provide dynamic stability to the lumbar spine may act to maintain the neutral zones of the motion segment within more normal limits during functional activity. In addition, the results of this study indicate that a "specific exercise" treatment approach directed at specific muscles is more effective than other conservative treatment approaches commonly used in patients with this condition. This intervention may provide a significant and viable alternative treatment approach in a patient population where such pathology is commonly treated with surgical fusion. Finally, this treatment approach may also have implications for the wider LBP population when "instability" of the lumbar spine is suspected.

APPENDIX

CONSENT FORM

I _____ agree to take part in the research study conducted by **MUSTAFA NAJMUDDIN** Postgraduate student (MSPT Neuro-musculoskeletal), LIAQUAT NATIONAL SCHOOL OF PHYSIOTHERAPY, entitled "**THE DETERMINE LUMBAR STABILITY EXERCISE TO IMPROVE LUMBAR INSTABILITY**."

I acknowledge that the research study has been explained to me and I understand that agreeing to participate in the research means that I am willing to

- Provide information about my health status to the researcher
- Allow the researcher to have access to my medical records, pertaining to purpose of the study
- Participate in evaluator program
- Make myself available for further follow up

I have been informed about the purpose; procedures, measurements and risks involved in the research and my queries towards the research have been clarified.

I understand that my participation is voluntary and can withdraw at any stage of the research project.

I understand that no monitory benefit will be given for participation in this research study.

Name of the applicant _____

ASSESSMENT FORM

Assessment Form For Low Back Pain

Serial no:	Date	Group:
Name:	Age:	Gender:
Occupation:	Contact no:	
Address:		

Height: _____ Weight:_____

PAIN HISTORY:

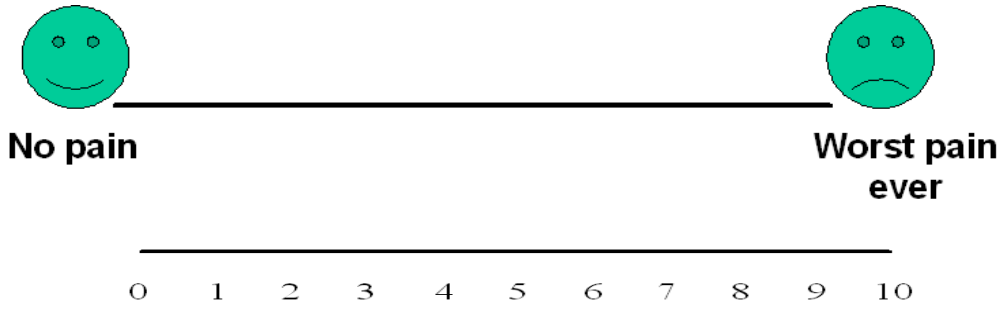
Site of Pain:_____ Nature of Pain: _____

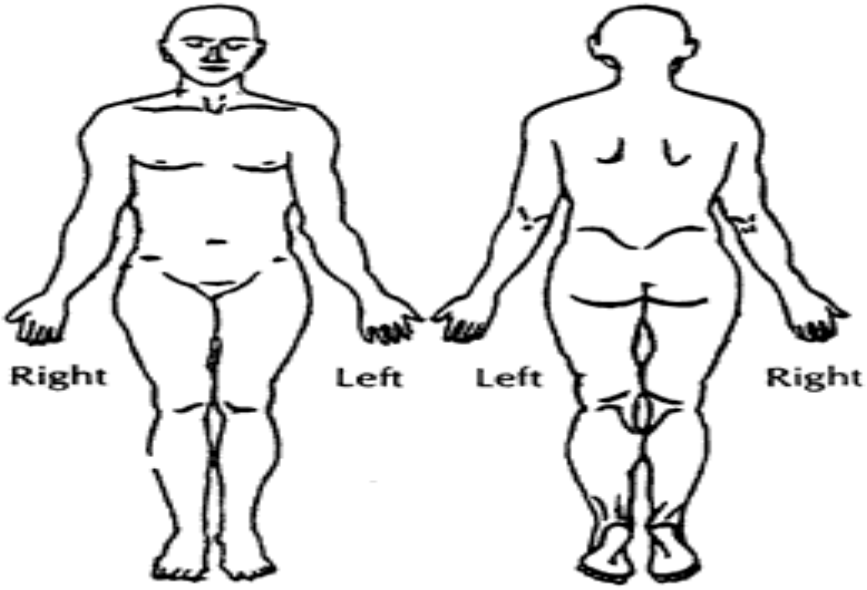
24 hour pattern:_____ Duration of pain:_____

Aggravating factors: _____

Relieving factors: _____

Visual Analog Scale (VAS): Is a self-pain rating scale. The scale consists 0-10,where the subject has to mark his pain on the scale given below.





MODIFIED OSWESTRY LOW BACK PAIN DISABILITY QUESTIONNAIRE (MODI)

Section 1: To be completed by subject

The subjects will be instructed to mark only the line which most closely describes your current condition.

Pain intensity:

- The pain is mild and comes and goes.
- The pain is mild and does not vary much.
- The pain is moderate and comes and goes.
- The pain is moderate and does not vary much.
- The pain is severe and comes and goes.
- The pain is severe and does not very much.

Personal Care (Washing, Dressing, etc.)

- I do not have to change the way I wash and dress myself to avoid pain.
- I do not normally change the way I wash or dress myself even though it causes some pain
- Washing and dressing increases my pain, but I can do it without changing my way of doing it
- Washing and dressing increase my pain, and i find it necessary to change the way I do it
- Because of my pain I am partially unable to wash and dress without help
- Because of my pain I am completely unable to wash and dress without help

Lifting

- I can lift heavy weights without increased pain

- I can lift heavy weights but it causes increased pain
- Pain prevents me from lifting heavy weights off the floor but i can manage it if they are conviently positioned (table etc)
- Pain prevents me from lifting heavy weights off the floor but i can manage light to medium weights if they are conviently positioned (table etc)
- I can lift only very light weights
- I cannot lift or carry anything at all

Walking

- I have no pain while walking
- I have pain when walking but i can still work my required normal distance
- Pain prevents me from walking long distance
- Pain prevents me from walking intermediate distance
- Pain me prevents from walking even short distance
- Pain prevents me from at all

Sitting

- Sitting does not cause me any pain
- I can only sit as long as I like providing that i have my choice of sitting surface
- Pain prevents me from sitting for more than 1 hour
- Pain prevents me from sitting for more than half hour
- Pain prevents me from sitting for more than ten minutes
- Pain prevents me from sitting at all

Standing

- I can stand as long as I want without increasing my pain

- I can stand as long as I want but my pain increases with time
- Pain prevents me from standing more than 1 hour
- Pain prevents me from standing more than half an hour
- Pain prevents me from standing more than ten minutes
- I avoid standing because it increases my pain right way

Sleeping

- I get no pain when I m in bed
- I get pain in bed but it does not prevent me from sleeping well
- Because of my pain, my sleep is only $3/4^{th}$ of my normal amount
- Because of my pain, my sleep is only 1/2 of my normal amount
- Because of my pain, my sleep is only $1/4^{th}$ of my normal amount
- Pain prevents me from sleeping at all

Social Life

- My social life is normal and does not increase my pain
- My social life is normal but increases my level of pain
- Pain prevents me from participating in more energetic activities (exercises, dancing etc)
- Pain prevents me from going out very often
- Pain has restricted my social life at my home
- I have hardly any social life because of my pain

Travelling

- I get no increased pain when travelling

- I get some some pain while travelling, when none of my usual forms of travel make it any worse
- I get increase pain while travelling, but it does not cause me to seek alternate forms of travel
- I get increase pain while travelling which causes me to seek alternative forms of travel
- My pain restricts all form of travel except that which is done while I m lying down
- My pain restricts all form of travel

Employment/Home making

- My normal job or home making activities that do not cause pain
- My normal job or home making activities increase my pain, but i can still perform all that is required of me
- I can perform most of mine job or home making duties, but pain prevent me from performing more physically stressful activities (exercise, lifting etc)
- Pain prevents me from doing anything but light duties
- Pain prevents me from doing even light activities
- Pain prevents me from performing any job or home making

	Pre	Post
VAS		

Modified Oswestry Disability Index (MODI)

	Pre	Post
MODI		

To be filled by physical therapist

Score: Initial_____% **Post_____%**

Date_____ **Date _____**

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