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AN IN-DEPTH EXPLORATION OF LOW BACK PAIN: CAUSES, CONSEQUENCES, AND TREATMENT APPROACHES

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Abstract: Low back pain (LBP) is a common and complicated health issue that affects a large proportion of the world's population. This detailed review of LBP focuses on its aetiology, impact on individuals and society, and various management strategies. The paper synthesises current literature to investigate the various components that contribute to LBP, including as anatomical, biomechanical, psychological, and lifestyle-related factors. Furthermore, the review emphasises the physical, emotional, and social repercussions of LBP, emphasising the importance of proactively addressing this health issue. Furthermore, evidence-based management techniques, such as non-pharmacological therapies, pharmacotherapy, and interdisciplinary treatments, are being thoroughly assessed to help healthcare practitioners provide the best possible care to LBP patients. This overview serves as a resource by emphasising academic integrity and relying on credible sources.

Index Terms **-** Low Back Pain, Phsiotherapy**.**

I. INTRODUCTION

Chronic low back pain is a pain that affects the lumbar back more than 3 months and that can have a longer healing period. It is the most common musculoskeletal problem nowadays . At some time in life 70-85% of all people have back pain. The annual prevalence of back pain is 15% to 45%.In the USA, low back pain is the most common problem in younger people. It is the second most important reason to go to the physician, the fifth ranking cause for admission to the hospital, and the third most important cause for surgery. Each year 2% of workers in the US were affected due to low back pain. In chronic low back pain sometime the etiology is not clear. Therefore the nonspecific term is used.[1]

Lumbosacral Complex

The lumbosacral complex is the important functional unit of the body. The lumbosacral complex consists of 5 Lumber vertebrae and the sacrum. Due to the weight-bearing function of the Lumbar vertebrae, they are large and massive. In the Lumbar region, the spinal canal is smaller and triangular than the cervical region. Short, strong pedicles arise from the vertebral body at the sides of the upper portion that proceed posteriorly to form the superior and inferior vertebral notches. The spinal nerve pass through the inferior portion of the pedicle above and the superior portion of the pedicle below from the intervertebral foramen.

There is an intervertebral disc with a central nucleus, surrounded by annulus fibrosus in each intervertebral space. The lumbosacral complex consists of a series of joints, musculoligamentous structures, with neural elements in close proximity.

Structural and Biomechanical Vulnerabilities of the Lumbosacral Complex:

Implications for Injury and Disc Prolapse at the L5-S1 Intervertebral Segment

The L5-S1 intervertebral segment of the lumbosacral complex exhibits inherent structural and biomechanical inadequacies, rendering it susceptible to injury and disc prolapse.

Bony Configuration:

a) The L5-S1 segments bear the maximum weight of other intervertebral joints, exposing them to increased mechanical stress.

b) The center of gravity passes directly through these vertebrae, accentuating the load they bear.

c) As the transition zone between the relatively fixed pelvic girdle and the freely mobile lumbar vertebrae, the L5-S1 junction is subjected to complex movements and forces.

d) The abrupt change in angle at these two vertebrae makes them more prone to instability or slippage.

e) Reduced spinal canal space at the L5 level heightens susceptibility to compression.

f) The L5-S1 junction experiences 60%-70% of the spinal flexion[2]**.**

Ligaments: The stability of the lumbosacral and sacroiliac complexes heavily relies on the posterior longitudinal ligament. Disc prolapse occurs when this ligament tears. A weak posterior longitudinal ligament contributes to lateral protrusion of the lumbar disc. Physiological lumbar lordosis leads to excessive stress on this ligament. The anterior longitudinal ligament spans the entire length of the vertebral column, providing anterior stability and restricting excessive extension of the spine. The supraspinous ligament, extending up to the spinal process of L5, contributes to excessive mobility in the L5-S1 segment. Additionally, sacrospinous, sacrotuberous, ventral, and dorsal sacroiliac ligaments, as well as the iliolumbar and interosseous ligaments, provide strength and stability to the sacroiliac complex directly and indirectly to the lumbosacral complex.[1]

Muscles: The erector spinae muscles, including iliocostalis, longissimus, and spinalis, play a crucial role in providing support to the lumbosacral complex. The rectus abdominis muscles contribute to anterior stability and cushioning by increasing intraabdominal and intrathoracic pressures, providing leverage for spine flexion. However, the psoas muscle, originating from the spine, can induce instability when contracting strongly during movements like resisted hip flexion.

Blood Supply: Spinal arteries, derived from vertebral arteries of the cranial region, supply the caudal portion of the cord. The posterior and anterior spinal arteries, along with branches from the upper lumbar and lower intercostal arteries, reinforce the spinal arteries. The radicular artery, a significant branch of the spinal arteries, travels along the nerve root, and its compromise can result in cord necrosis below that level.[1, 2]

Nerves: The L5-S1 segment receives its major nerve supply from nerves of Von Luschka and the posterior and anterior primary divisions of the nerve roots**.**

Biomechanical Factors: The shearing normal sacral angle, approximately 40 degrees, experiences a shearing force of 65%. An increase in anterior tilt intensifies the shearing force, leading to exaggerated lumbar lordosis, while a decrease flattens the normal lordotic curve.

Etiology

Chronic Low Back Pain arises due to various reasons:

1. Traumatic: vertebral fracture, sprain, strain
2. Structural defect: mainly in the vertebral spine (example- sacralization, scoliosis, spondylosis, spina bifida)
3. Degenerative: osteoarthritis, degenerative disc disease
4. Discogenic Low Back Pain: due to lesion in the disc
5. Neoplastic: benign or malignant tumors
6. Metabolic: osteomalacia, osteoporosis
7. Idiopathic Low Back Pain
8. Miscellaneous causes**;** Potbelly, Functional backache. Habitual bad posture

Pathology:

To identify the pathology of chronic low back pain evaluation and physical examination are necessary and these include the following[17]:

(1) History
(2) Examination of Posture
(3) Evaluation of Pain characteristics
(4) Palpation
(5) Range and Rhythm of Spinal Movement
(6) Neurological Examination
(7) Diagnostic Physical Tests
(8) Evaluation of Functional Status

(1) **History:**

Present and previous history related to the present problem, its treatment, and the response. Signs and symptoms indicating infection, vascular disease, rheumatic affection, tumor, systemic disease, the endocrinal and gynecological disease should be carefully screened to rule out these. Vascular lesions, genitourinary disorders, gastrointestinal lesions, viscerogenic known to cause referred chronic low back pain. Postures adopted for longer periods example - sedentary games and watching TV should be noted.

(2) **Examination of Posture:**

Normal posture curve and gait observed in front, back and side.

ASSESSMENT OF PELVIC TILT:

- Anterior pelvic tilt: It occurs as a result of protruding abdomen (example- obese people, tight hip flexor, tight low back muscles, weakness in abdominal muscles, spondylolisthesis, tight hamstring. So it puts excessive pressure on the posterior aspect of the vertebral bodies and facets when is present.
- Posterior pelvic tilt: It results from tight or over developed low back muscles. Localized muscular spasm or weakness of hip flexors may result in the obliteration of normal lumbar lordosis into a flat back.
- Lateral pelvic tilt: In this pelvic drops on one side. It could be due to structural scoliosis, unilateral muscle spasm, unilateral lumbosacral strain, or length disparity.

OBJECTIVE MEASUREMENT OF PELVIC TILT:

- Posterior or anterior pelvic tilt is measured on a lateral view radiograph. The normal angle is 30%. It increases in the lordotic curve.
- The lateral pelvic tilt is measured by leg length when there is leg- length discrepancy. It can be accessed by measuring the difference in the true horizontal line and the horizontal line passing over the tips, bony prominences of the posterior or anterior iliac spine.

(3) Evaluation of Pain Characteristics:

Characteristics of pain, type, site, and behavior provide a diagnosis of chronic low back pain.

- Where- furnishes information about its location
- When- indicate the duration, time, posture
- How- relates to the position
- Sharp, stabbing, burning pain originates from the nerves
- Nonspecific pain present due to soft tissue inflammation, and radiating pain arises a result of nerve pathology.

(4) **Palpation:** It recognizes specific tissue at fault. It can be done in a prone position with firm pressure in the anterior and lateral direction. Each spinous process is palpated over the paravertebral, interspinous areas, lumbosacral junction and sacroiliac joint.Bony tenderness is also palpated. Localized muscular tenderness can be checked by picking up and rolling manipulations of various muscle groups. Deep Tenderness is tested on the sciatic notch with the heel of the hand, pressure is applied to detect tenderness over the intervertebral joint. Palpation over the spinous process and intervertebral joint to test alignment. With undue prominences of the spinous process, lumbar lordosis indicates spondylolisthesis.

(5) **Rhythm and Range of the spinal Movements:** The lumbosacral complex can be measured in flexion, extension, lateral flexion, and rotation to either side.

- FLEXION: In this, ask the patient to bend forward from stride standing and knee are extended. In this lumbar lordosis gradually flattens and turns into kyphosis at the terminal range of flexion. The patient attains an erect posture in flexion. Pelvic derotation occurs and lumbar kyphosis changes into lumber lordosis. The normal range is 80 degrees.

- EXTENSION: Erect stride standing posture patient is asked to extend the whole spine beyond midline to maximum range. This produces compression on the posterior vertebral body, facet joint with the opening of vertebral bodies anteriorly. Compression produces pain. The normal range is 20-30 degrees.

- LATERAL FLEXION: In this ask the patient to bends the trunk with knee extension and side sliding his hand near the floor as possible from the lateral aspect of the hand. It compresses tissue and stretches the tissue.

- ROTATION: It can be tested lying or sitting with hip and knee in flexion. Both right and left side movement is tested. The site of pain is noted.

  If flexion toward the painful side aggravates the pain, the lesion may be due to intraarticular pathology, or disc lesion. If lateral flexion is away from the side then the lesion may be of muscular or articular origin. The normal range is 40-45 degrees.

(6) NEUROLOGICAL EXAMINATION:

Neurological examination of the nervous system consists of sensory status, motor power, atrophy of muscle groups, tenderness, tendon reflexes.

- SENSORY STATUS: Sensory supply is carried by various dermatomes. Area of sensory deficits can be marked on the body chart to identify the level of the lesion and correlate with other test findings.

- MOTOR POWER: The muscle receives motor innervations from the specific nerve root. Myotomes provide information about possible levels of the lesion. Example –Adductor groups, hip flexors receive innervation from the L2-L3 segment and quadriceps receive the L3-L4 segment. When hip flexor weakness occurs quadriceps is normal. Manual Muscle Testing inadequate specific muscle group endurance rather than strength is a more precise test. Flexor hallucis longus weak before gastrocnemius in a lesion of L5-S1 level.

- MUSCULAR ATROPHY: Assessed when measuring the girth of the thigh and leg.

- MUSCULAR TENDERNESS: The tender area marked over the body chart provides integrity of reflex.
- KNEE JERK OR QUADRICEPS TENDON REFLEX: Done in sitting with knee hanging edge of the table or also in supine position and knee is flexed. With help of a hammer patellar tendon is taped with knee extension. If absent or sluggish it indicates lesion L4 root involving L3-L4 disc. Medial and lateral hamstring reflex is done in a prone position with the knee supported and flexed. Absent or reduced medial hamstring reflex response indicates a lesion on the L5-S1 level.

- ANKLE JERKS: It can be tested in supine, prone, or sitting positions assuring relaxation of the ankle. Absent ankle jerk indicates lesion at S1 root involving L5-S1 disc.
- PLANTAR RESPONSE: Scratching the sole of the foot produces sudden reflex contraction of extensor hallucis longus. This pulls the limb into flexion-abduction, internal rotation at the hip, and loss or weakness of response indicates lesion at S1.

(7) DIAGNOSTIC PHYSICAL TEST:

(a) SLR (Straight Leg Raising) or Laseque's sciatic nerve Test:
It causes traction on the sciatic nerve and it is a protective reflex test. It is done in the supine position. The appearance of pain when the distribution of sciatic nerve up to 45 degrees with hip flexion and knee extended indicates a positive SLR (Straight Leg Raising) test. When pain is felt aggravated by passive flexion of the neck and passive dorsiflexion of the foot it is a positive neural sign or positive SLR (Straight Leg Raising).[16]

(b) Bowstring Sign:
This SLR (Straight Leg Raising) is carried out until the pain is reproduced. At this point, the knee is flexed till the pain disappears. The examiner places this limb on the shoulder and places the thumb on the popliteal fossa over the sciatic nerve firm pressure on the nerve reduces pain in the back or radiating down the leg that indicating a positive bowstring.

(c) Slump test for mobility at the intervertebral foramen and the spinal cord:
SLR (Straight Leg Raising) or passive neck flexion helps to detect a reduction in mobility of pain. The patient is in a slouch sitting position with the knee edge of the table. The examiner bends the head and trunk forward, bringing the head down in between the knee. Examiner asked the patient to extend the knee alternately to maximum and the foot in dorsiflexion. If attempting knee extension, pain is produced, then the limited range is noted. Positive tests indicate interference of the mobility at the intervertebral foramen or the vertebral canal.
Test for sacroiliac irritation :

(d) Gaenslen's Test :
In this ask the patient to lie down on the side-lying position on the unaffected hip joint. Ask the patient to flex the unaffected hip to the knee-chest position. The physiotherapist passively extends other hip joint and keep the knee straight. This produces rotary strain on the pelvis and tends to rotate half of the ilium against the sacrum, eliciting pain at the SI (Sacroiliac) joint in presence of SI (Sacroiliac) joint pathology.

(e) Test for hip pathology : (Faber's sign)
When the patient, flexed, abducts, and externally rotates the hip, pains occur. In this ask the patient to lie in the supine position. A full range of passive internal and external rotation is attempted with slight overpressure at the end of the range. If there is pain-free ROM (Range Of Motion) with the overpressure, the hip pathology is eliminated.

OTHER INVESTIGATIONS:

1. CT (Computed Tomography) scan
2. MRI (Magnetic Resonance Imaging)
3. EMG (Electromyography)
4. Rectal and pelvic Examination

(2) EVALUTATION OF FUNCTIONAL STATUS :
Evalutation of ROM (Range Of Motion), endurance, and muscle strength can be checked on activities of daily living and should be rated on a graduated numerical scale.[8]

FUNCTIONAL ACTIVITIES :
Functional activities are:-

1. Personal hygiene
2. Dressing
3. Level Walking
4. Running
5. Walking up steps and incline, coming down

SCORING SCALE FOR FUNCTIONAL ACTIVITIES :

The scoring scale for functional activities is:-
0= Person unable to perform the activity
1= Person able to perform only with adequate assistance
2= Person able to perform with minimal assistance
3= Person able to perform independently but has pain while performing
4= Person is able to perform pain-free normal activity

SYMPTOMS :

The most common symptom of chronic low back pain is pain and stiffness in the back. Other symptoms are paraesthesia or weakness in the lower limb. Pain is of many types like localized or chronic, sharp and diffuse pain. Sciatica is a term that describes intense pain radiating from the buttock into the thigh and calf. Stiffness may be sudden and continuous and worse in the mornings. Usually, the deformity is noticed by others, but a patient may become aware of shoulder asymmetry and clothes not fitting well. Anywhere in the lower limb numbness or paraesthesia is felt. Urinary retention or incontinence can occur due to pressure on cauda equine. Faecal incontinence and impotence may also occur. Urethral discharge, sore eyes, and diarrhea are also symptoms of chronic low back pain.

PHYSIOTHERAPY MANAGEMENT

AIM :

1. Decrease pain
2. Improve posture
3. To improve flexibility and mobility
4. Strengthen back muscles
5. Improve Endurance of back muscles
6. Decrease mechanical stress on spinal structures

PHYSIOTHERAPY TREATMENT:

1. Awareness of diagnosis:

First, the important responsibility of the physiotherapist for effective management is to gradually convince the patient to accept the diagnosis.

2. Choice of the correct modality:

There is no study about the efficacy of a particular modality of physiotherapy. However TENS (Transcutaneous Electrical Nerve Stimulation) is effective in 83.8% of patients with chronic LBP (Low Back Pain)[3].

3. Exercises:

(a) Strengthening exercises : To strengthen the back extensor muscles , exercises play a very important role in the control of Chronic Low Back Pain. Better physical fitness achieve when improving the tone erector spinae.[8]

(b) Endurance exercises: Endurance of the large muscle group improvement plays a decisive role. Endurance exercises increase endorphin levels in the blood and CSF (Cerebrospinal Fluid).

(c) Isometrics : Strong isometric exercises are very effective in Chronic Low Back Pain, especially of myofascial origin.[9]

(d) Progressive mobility and active exercises : It is important to improve the flexibility of the body and ease of function.[14]

(e) Physical Fitness through aerobics : It is helpful in decreasing muscular tension. Aerobics increases the alpha-wave activity. It succeeded by relaxation techniques such as shavasan should be ideal for feeling well-being or inducing freshness aerobics such as cycling, brisk walking, and swimming. It provides a diversion from pain.[4]

(f) Specific exercises and body mechanics: Chronic Low Back Pain cause recurring strain, biomechanically controlled body mechanics, and also back care program should be emphasized.[10]

4. Physiotherapy Modalities:

(a) Ultrasound : It increases the cortisol which is present in the spinal nerve roots and lumbosacral plexuses. They improve mobility and decrease pain. It also reduces spasms.[15]
(b) Transcutaneous Electrical Nerve Stimulation : TENS (Transcutaneous Electrical Nerve Stimulation) reduces perceived pain by elevating endogenous opiate levels in the spinal cord and brain. Also, it reduces perceived pain by continuous stimulation of continuous afferent that blocks pain in substantia gelatinosa of the spinal cord.[6]
(c) Diathermy : It provides deep heating in the tissue over a large area. Two modes of diathermy: continuous or pulsed. In Chronic Low Back Pain continuous mode of diathermy is given. [15]

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