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Exercise and Manual Therapy for Treatment of Low Back Pain with or without Lumbosacral Radiculopathy: A Narrative Review

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BACKGROUND:

Low back pain with lumbosacral radiculopathy is also considered as a self-limiting condition by many authors. Almost 50% cases resolve by one or two weeks and around 90% cases resolve by six months. [1] Whereas chronic low back pain with lumbosacral radiculopathy mostly causes disability. [2.] It is also considered as one of the leading cause of disability in people under 45 years of age and third cause of disability above 45 years of age. [3.] It has been seen that lumbosacral radiculopathy is the leading cause of disability in the developed world and accounts for billions of dollars of healthcare costs annually.[1] Low back pain (LBP) alone affects up to 80% of the population at some point in life, and 1% to 2% of the United States adult population is disabled because of LBP. Various survey data on the prevalence of LBP estimates range from 28% to 40% of the population. Various study in United states shows the increase in low back pain patient reporting to clinic for treatments.

Lumbosacral radiculopathy refers to symptoms of pain, tingling, numbness or weakness that travel down the low back and into the lower extremity. Usually low back pain is accompanied with lumbosacral radiculopathy. Lumbosacral radiculopathy usually occurs due to impingment of the nerve or nerve root caused by a disc herniation or foraminal compressions. Most of the population has encountered low back pain and radiculopathy in their life time. A major portion of the patients visit the physiotherapy departments with low back pain with or without radiculopathy every year. Although the incidence of low back pain is estimated to be 5% to 10% with a lifetime prevalence of 60% to 90%. [1]The prevalence of lumbosacral radiculopathy varies from about 2.2% to 8% and the incidence ranges from 0.7% to 9.6%. [4]

Friedly J et al reported two reports which says increase from 12% in 1998 to 15% in 2004 and 3.9% of the population in 1992 to 10.2% in 2006 concluding steady increase in the incidence rate. [5] Limited information is available regarding the prevalence of chronic LBP with or without lumbosacral radiculopathy in low and middle- income countries. A study done in Tamil Nadu, India shows 23% of population complains of low back pain and 30% among them have radicular pain. [2] Another study done on northern India also shows around 23.09% of patient having low back pain who visited the out patient department. [6] They have also found that 67% patients had psychosocial issues, 57% were in blue-collar jobs. The increasing rate of low back pain and lumbosacral radiculopathy is due to the poor health status and poor body mechanics. Increase in sedentary life style has reduced the health status of individuals. In India most of the blue collared job profile shows people mostly uses unscientific ergonomics in their jobs. A study done in Kolkata, India shows 7 days point prevalence is 36% where 82% out of 500 auto rickshaw drivers had low back pain and 79.8% had pain in the last 12 month period, where the authors mentioned the poor ergonomic posture as the major cause of low back pain. [7] Sharma et al had also mentioned that 26% of patient with low back pain had to change/leave their profession, and 38% did not enjoy their present job. [6]

So it can be considered that low back pain is one of the major health issues in modern days, and lumbosacral radiculopathy will add on mild to moderate disability in these patients. This in turn produce effects on health related quality of life.

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Treatment of low back pain with lumbosacral radiculopathy is usually done conservatively or surgically. Though various studies has advocated for each of the treatment procedure, conservative treatment is mostly chosen for as the first line of treatment. These conservative treatments are confined with rest, medication and physiotherapy. It has been seen that physiotherapy treatments give very effective result in reducing the symptoms of low back pain and lumbosacral radiculopathy. Various Physical therapy interventions as exercise, manual therapy, and electrotherapy have been used for treatment of lumbosacral radiculopathy and found to be effective.[8,9] However it has been seen that rest and electrotherapy treatment is mostly prefered for acute symptom management, but exercise and manual therapy is mostly preferred for the treatment of chronic low back pain and lumbosacral radiculopathy.

METHODOLOGY:

Various research articles were taken for review from Google scholar, Research gate and Pubmed. Key words used for article searched were; Physiotherapy for low back pain, Physiotherapy for lumbosacral radiculopathy, management of low back pain with lumbosacral radiculopathy,management of sciatica, treatment of low back pain with sciatica, exercises for low back pain with sciatica, manual therapy for low back pain with sciatica. All the articles selected were open access articles published in last 25 years and written in English. The references of selected articles were used for further article searches. Books about various manual therapy were cross checked for the manual therapies mentioned by authors in the selected articles.

Articles selected for review were based on the physiotherapeutic treatments of low back pain with or without radiculopathy. Within these studies, those who have included exercise therapy and manual therapy treatments were selected.Review article, randomized control trial, comparison and case studies were included to visualize the trend of selection of exercise and manual therapy by the physiotherapists around the world. Articles selected for final critical appraisal were 5 Indian, 2 European, 3 Australian and 5 African.

RESULTS:

63 articles were checked through within which 44 articles were selected to meet the inclusion after abstract reading. After reading the full article, 15 articles were finally selected where physiotherapy treatment is only discussed. Analysis of studies on effects of exercise on low back pain with or without radiculopathy done, which includes 7 studies (Table 1). Analysis of 8 articles done which were worked on effects of manual therapy on low lumbosacral radiculopathy (Table 2).The studies showed that mostly exercise only helps in reducing the low back pain where as manual therapy showed better result in reducing the symptoms of radiculopathy. Critical appraisal of the studies done to narrate the effectiveness of exercise and manual therapy separately for low back pain and radiculopathy.

Studies advocating exercises:

2 RCT, 2 comparative study and 3 review articles were analysed. Both RCT has done on effects of exercises on chronic low back pain with or without radiculopathy. Whereas one study also evaluated the effects of bed rest in acute low back pain. Both studies had evaluated the pain intensity, disability and status of activity or range of motion with valid and reliable outcome measures. Authors of both articles concluded that exercise can reduce the pain intensity, disability and improve activity or ROM in chronic low back pain. Exercises used in these articles were ,designed or selected to improve function and movements. Between the 2 comparative studies one study has compared general exercises with lumbar spine stability exercise which is a type of core stability exercise, and concluded as lumbar spine stability exercise is more effective treatment. Whereas the next study compared core stability exercise with electrotherapy and EMG biofeedback supported core stability exercise with same electrotherapy treatments, and concluded that EMG biofeedback supported core stability is better choice of treatment. Both the studies used pain and disability as variables measured with valid and reliable outcome measures.The 3 review articles selected in this study has collectively evaluated 70 RCT's (29+6+35).Authors of 2 review studies has accepted RCT's of low back pain patients of all variants i.e. acute, sub acute, chronic low back pain with or without radiculopathy. Authors of another review study had included RCT's on non specific chronic low back pain. All the RCT's of these review

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articles had analysed the effects of exercises based on the outcome of pain, activity or flexibility and endurance. The exercises discussed for their effectiveness were generalized exercise and targeted exercise such as McKinzie exercise and motor control exercise. The results showed that all exercise prescriptions provide good effectiveness in improving the variables in short term, mid term and long term follow up in global impressions of low back pain.

Table 1: Studies of exercise therapy

Author	Study design	Method	N	Result	Variables/Outcome measures	Conclusion
Kaur G et al 2016[10]	Comparative study	Core stability exercises versus EMG biofeedback assisted core stability exercises. All patients received electrotherapy treatment.	30 patients	EMG biofeedback assisted core stability exercises significantly ($p<0.05$) worked better than simple core stability exercise.	Pain (NPRS) Disability (ODQ)	EMG biofeedback assisted core stability exercises are helpful for LBP to reduce pain, radicular pain and disability
Saragiotto BT et al 2016 [11]	Review	Electronic searches in CENTRAL, MEDLINE, EMBASE, five other databases up to April 2015ll	29trials (n = 2431)	Very low to low quality evidence that Motor control exercise (MCE), is clinically more effective than exercise and electrophysical agents	MCE, Pain, disability, global impression of recovery and quality of life	There is very low to moderate quality evidence that MCE has a clinically important effect compared with a minimal intervention for chronic low back pain.
Ye C.et al 2015 [12]	Comparative study	lumbar spine stabilization exercise (LSSE) versus general exercise (GE)	63 male adults (20-29 yrs)	Improvement in both groups, LSSE better than GE Followup 1 year	Pain of lower back and legs with VAS Functional capacity evaluated with ODI	Both exercises are effective, LSSE is more effective than GE, and physical therapy for young male patients with lumbar disc herniation
Costa L O et al	Randomized placebo-	Twelve sessions of	154 patients	The exercise intervention	Quality of life Pain	Motor control exercise

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2009 [13]	controlled trial	motor control exercise versus placebo		improved activity and patient's global impression of recovery but did not clearly reduce pain		produced short-term improvements in global impression of recovery and activity, but not pain, for people with chronic low back pain
Slade SC et al 2007 [14]	Systemic review	As per Cochrane Back Review Group and Quality of Reporting of Meta-analyses (QUORUM) guidelines.	6 high-quality RCT	Effects favored unloaded movement facilitation exercises of McKenzie compared to other or no exercise and were comparable for yoga.	Pain (VAS) Disability (ODI)	For NSCLBP, there is strong evidence that unloaded movement facilitation exercise, compared to no exercise, improves pain and function.
Rainville J et al 2004 [15]	Review	Computerized literature search of MEDLINE	35 trials	Exercise improve or eliminate impairments in back flexibility and strength, and improve performance of endurance activities, reduce the intensity of back pain, reduce back pain–related disability.	Evidence concerning exercise, the risk of back pain, changes in back pain, exercise for chronic low back pain and disability	Exercise is safe for individuals with back pain. Exercise can be used as a therapeutic tool to improve impairments in back flexibility and strength. Exercise can reduce the behavioral, cognitive, and disability.
Malmivaara A et al 1995 [16]	Controlled trial	Bed rest for two days versus Back-mobilizing	186 subjects	Control group had significant advantages over the bed-	Number of sick days, pain intensity, ability to work,	Continuing ordinary activities within the

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		exercises versus Continuation of ordinary activities as tolerated		rest group and exercise group. Follow-up 3 and 12 weeks	lumbar flexion, and Oswestry back-disability index	limits permitted by the pain leads to more rapid recovery than either bed rest or back-mobilizing exercises in acute low back pain

EMG- Electromyography, NPRS- Numeric Pain Rating Scale, ODI- Oswestry Disability Score Index, LBP- Low Back Pain, MCE- Motor Control Exercise, LSSE- Lumbar Spine Stabilization Exercise, GE- General Exercise, VAS- Visual Analogue Scale, NSCLBP- Non Specific Chronic Low Back Pian

Studies advocating manual therapy:

4 RCT, 1 comparative study, 1 case study, and 2 review articles were analysed. In all 4 RCT's effects of manual therapy on patients with lumbar radiculopathy was evaluated. Neural mobilization was preferred manual therapy used in all the studies, whereas a study had also included spinal mobilization and another included Mulligan's spinal mobilization with leg movements.Pain intensity, disability was evaluated to quantify the outcome. EMG and MRI findings were also used to analyse the outcome for manual therapy in few of these studies. The comparative study had also compared the effects of neural mobilization in relation to lumbar traction in lumbar radiculopathy patients. Pian and disability was evaluated here too identify the effectiveness of interventions. The case study included in this review had used Maitland's mobilization technique in various grades along with trigger point release and exercise to reduce lumbar radiculopathy. Pain, range of motion, activities were evaluated for finding out the effects of intervention. The 2 review articles considered here had discussed 28 RCT's (14+14) and one cohort study, showed that spinal mobilization is one of the commonest and most successful treatments approach for lumbosacral radiculopathy patients along with exercise and physiotherapy modalities.

Table 2: Studies on radiculopathy and manipulation

Author	Study design	Method	N	Result	Variables/ outcome measures	Conclusion
Danazumi MS 2019 [17]	Narrative Review	All type of studies on Physiotherapy management of lumber disc herniation with radiculopathy were included from PumMed, Pedro and OTseeker database	15 studies	1cohort study and 14 RCT discussed in the article. Out of which 5 studies were on effects of physical therapy modalities, 6 studies were on effects of physical therapy/exercises , and 4 studies were on effects of	level of evidence was determined using the standardized criteria recommended by the Oxford Center for Evidence	EOTA, SM and LSEs in combination with LPLT are better than any physiotherapy intervention in the management of LDHR

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				spinal manipulation (SM). The studies were presented and discussed.		
ELDesoky MTM et al 2016 [18]	RCT	Neural mobilization with conventional treatment versus conventional treatment	60 patients	Improvements in both treatments, however more significant (p,0.05) improvement in neural mobilisation	H-reflex latency, amplitude, and H/M ratio for assessing S1 nerve root function, pain (VAS), Functional Disability (ODI)	Neural mobilization technique is an effective intervention for reduction of pain, functional disability and enhancing physiological function of the nerve root in low back pain with lumbosacral radiculopathy
Nagulkar J et al 2016 [19]	Comparative study	Active Neural Mobilizationduring Intermittent Lumbar Traction versus Intermittent Lumbar Traction followed by Active Neural Mobilization in Lumbar Radiculopathy patients	107 patients	ANM during ILT showed better result than ILT followed by ANM in patients of LBP with Radiculopathy	Pain (VAS) P1 and p2 level while SLR Disability (ODI)	that ANM during ILT gives more relief and yields better responses in patients of LBP with radiculopathy
Thakur A et al 2015 [20]	RCT	Mulligan's SMWLMs versus Shacklock NTMs All patients received conventional treatment	102 patients	SMWLM shows improvements in SLR, pain, spinal ROM (p>0.05) than Shacklock NTMs. Non significant difference between both manipulation on disability (ODI scores)	Pain (VAS), spinal ROM, SLR range and Disability (ODI)	Patients treated with Spinal Mobilization with Leg Movement technique produce more significant improvement than those treated with Shacklock Neural Tissue Mobilization in leg pain intensity, lumbar range of motion and

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						back specific disability
Adel SM 2011 [21]	RCT	lumbar spine mobilization and exercise intervention versus Straight leg raising stretching (SLR) in addition to lumbar mobilization and exercise	60 patients	significant improvement by SLR on pain (p = 0.006), functional disabilities improvement (0.001), location of symptoms (p = 0.083) and sciatic nerve root compression (p = 0.035). There is no significant Differences in H-reflex latency (p = 0.873) between treatments	Distribution of symptoms (body diagram), Pain (NPRS), Disability (ODI)	It is concluded that straight leg raising (SLR) stretching may be beneficial in the management of patients with LBD. SLR stretching in addition to lumbar spine mobilization and exercise was beneficial in improving pain, reducing short-term disability and promoting centralization of symptoms in this group of patients
Basson A 2011 [22]	Review of surveys	Survey studies on physiotherapy management for low back pain	14 studies	Most frequently used treatments for LBP were education/ advice (68%), exercise (60%) spinal mobilisation (51%), electrotherapy (49%), McKenzie (47%) and hot packs/ heat (41%). The intervention least used was manipulation (9.5%).	Physiotherapy management procedures	Over a 14 year period there were no major changes in the way physiotherapists manage LBP.
Riley JA 2011 [23]	Case study	A manual therapy treatment approach which is Maitland approach (lumbar rotation mobilisations),	One 47 year old female patient	Patient was symptom free after 7 manual therapy treatment sessions	range of all lumbar movements, SLR, neurological conduction	Manual therapy treatment can help in reducing severe radicular pain

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		massage, trigger point pressure release and Transversus Abdominus muscle activation				and neurological deficit, signs and symptoms on lumbar radiculopathy patients. Altough it cannot be generalized
Sarkari, E et al 2007 [24]	RCT	Neural mobilisation with conventional treatment versus conventional treatment for sciatica patients	30 patients	Neurla mobilization with conventional treatment showed better result than conventional treatment alone.	Hip ROM (SLR) Pain (VAS)	Neural mobilization helps in reducing pain and increase hip ROM in sciatica patients

SM- Spinal Manipulation, EOTA- Extension-Oriented Treatment Approach, LSE: Lumbar Stabilization Exercises, LPLT- Low Power Laser Therapy, LDHR- Lumbar Disc Herniation with Radiculopathy, VAS- Visual Analogue Scale, ODI- Oswestry Disability Score Index, ANM- Active Neural Mobilization, ILT- Intermittent Lumbar Traction, LBP- Low Back Pain, SMWLM- Spinal Mobilization with Leg Movements, NTM- Neural Tissue Mobilization, SLR- Straight Leg Raising, ROM- Range of Motion, NPRS- Numeric Pain Rating Scale, LBD- Low Back Disabilities

DISCUSSION:

The studies identified for this review are categorized under 2 categories and discussed based on the treatments suggested.

Effects of Exercise for Low back pain with or without radiculopathy:

In general, most studies had discussed about the effectiveness of various exercises in low back pain in respect to how they work on improving the pain intensity of the patients. Along with pain, disability, activity or flexibility of low back region, and endurance is also evaluated. Various exercise seems effective in reducing the symptoms, among whichcore stability exercise, motor control exercise, open kinetic McKinzie exercise and general exercises were mostly used by the clinicians.

Core stability exercise is one of the most preferred exercise by clinicians and studies also showed that it always improve pain intensity and disability. The most preferred core stabilization exercises are targeted to improve the lumbar spine stability by improving abdominal strength and strengthening of small lumbar spine stabilizers. The patterns of exercises used by the researchers are targeted from static stabilisers to eventually the dynamic stabilisers of low back, which in terms provides more stability of low back and corrects the faulty posture, thus provides support to correct the pathology behind the source of low back pain.Once the pain reduces overall disability and activity improves in patients. Also with stronger core muscles the patient shows long term endurance of low back region. Kaur et al has had further shown the core stability exercises with EMG biofeedback gives better improvement than only core stabilization exercise, which is possibly due to the patient feel more in control of the pain since there be a way to influence and thus reduce the pain levels[10, 25]. Moritianiet al hypothesized that use of biofeedback in recognition of facilitation pattern is responsible for increasing the work of motor neurons that helps in improving strength and endurance [26]. An intervention of electrotherapy treatment in form of interferential therapy, short wave diathermy and low power laserwas also

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done in the studies to reduce the pain. Which again contradict the effects alone by core stabilization exercise to reduce pain, but suggest that it rather improves the disability and further activity of the patient. Overall evidence suggests core stability exercise with electrotherapy treatments reduces the low back pain, improves activity, reduces disability and provides long term effects on lumbar endurance.

Motor control exercise is another form of exercise regime which is used by physiotherapists to reduce pain and disabilities due to low back pain and radiculopathy.But when it come to provide evidence, very little information shows its effectiveness in long term. For the outcomes pain and disability there is low quality evidence that there is a small, but not clinically important, effect of motor control exercise (MCE) compared to other exercises in the short term and high quality evidence that there is no clinically important difference for intermediate and long term follow-ups [11] .However Cost L A et al showed short term effect on global impression of recovery and activity but not pain in chronic low back pain patients [13]. Overall the evidences suggest that motor control exercises don not have very effective role in improving pain and disability in low back pain patient with or without radiculopathy.

McKinzee exercise is used by physiotherapists for almost all back pain patients. These are a set of open kinetic or unloaded back and abdominal strengthening and stretching exercises. However if we follow the RCT's and reviews it is seen that most exercises used in research are targeted towards back and abdominal strengthening and stretching, which sometimes also the same as McKinzie exercises but coined as general exercise. The moto of prescribing exercises for low back patients with or without radiculopathy seems to ultimately facilitate the movements in the affected area as compared to no exercise or other means. There are plenty of research evidence available that shows exercise ultimately reduce the chance of ill effects of immobility as well as prevent joint stiffness and soft tissue tightness, and further improves blood circulation at affected structures, hence improves healing, reduces pain and facilitate activity.

Effects of Manual therapy for Lumbosacral radiculopathy:

As exercise seems to help in low back pain with or without radiculopathy, manual therapy shows better result with patients of low back pain with radiculopathy. Research articles reviewed in this study direct about major two manual therapy techniques as more effective than other physiotherapy treatment for lumbosacral radiculopathy that is neural mobilization and spinal vertebra mobilization. In most cases the researchers used these manual therapy along with conventional exercise, electrotherapy and ergonomic education.

About neural mobilization straight leg raising (SLR) was the choice of procedures for most researchers. Eldosky MTM et al compared neural mobilization with conventional treatment and found that neural mobilisation helps in improving pain, disability and muscle activation better than conventional treatments [18]. The electromyography findingsshowed better result in H reflex latency and amplitude after neural mobilization. SimilarlySarkari et al also found that neural mobilization with conventional treatment gives better result than conventional treatment only in improving pain, hip range of motion and activity [24]. Nagulkar J et al had compared neural mobilization with intermittent lumbar traction with intermittent lumbar traction and found that adding neural mobilization improved the symptoms better [19].

Danazumi MS had reviewed articles on lumbar disc herniated patients showing radicular pain and found that spinal mobilization and lumbar exercises are helpful in improving the lumbar disc herniation and it's symptoms [17].Similarly a case study by Riley JA showed spinal manipulation is beneficial in treatment of lumbar disc herniation and resultant radiculopathy than conventional treatments [23].Basson A et al had reported in their review on physiotherapy treatment for low back pain that in acute and chronic cases exercise and back pain related ergonomic advices should help, however if the symptoms do not subside spinal mobilizations/ manipulations will be helpful [22].

Adel SM had compared the effects of spinal mobilization and neural mobilization with spinal mobilization and found that neural mobilization with spinal mobilization helps better in improving the sciatic pain, functional disability, H reflex in electromyography and centralization of sumptoms [21]. In another study Thakur A et al has compared the effects of Mulligan's Spinal mobilization with leg movements (SMWLM)

and Shacklock neural mobilization [20]. They found that both were very effective in treatment of lumbosacral radiculopathy, however SMWLM seems to give quicker result in reducing radicular pain and disability.

CONCLUSION:

From the studies reviewed here it can be concluded that lumbar stabilization and strengthening exercise are beneficial in low back pain treatment. It helps in improving pain, disability and some extent in radiculopathy. Whereas spinal mobilization and neural mobilization is more effective in treatment of lumbosacral radiculopathy apart from spinal exercise. We also can suggest various ergonomic advices as an added support to physiotherapy treatments. It is suggested that a combination regime of exercise and manual therapy would be more beneficial in treatment of lowback pain with or without radiculopathy.

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