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COMPARISON BETWEEN MUSCLE ENERGY TECHNIQUE AND PILATES EXERCISES IN PATIENTS WITH NONSPECIFIC LOW BACK PAIN

[1]Dr.Saru Bansal, [2]Dr. Vivek Chauhan

[1]Associate Professor and Head of Physiotherapy Department , [2] Associate Professor

[1]Department of Physiotherapy

[1]Kailash Institute of Nursing and Paramedical Sciences, Greater Noida, Uttar Pradesh, India

Abstract:- **Background:** Low back pain is second only to common cold as a cause for office visits to physicians in adults and for work absence in people <55 years of age. Most people suffer an episode of low back pain during life. Several studies have studied the effect of mobilization and various electrotherapeutic modalities in low back pain patients but there are no recommendations of specific type of exercise to be undertaken for strengthening and stretching of core and pelvic floor muscles in low back pain.

Objectives:- To compare the effect of muscle energy technique and Pilates Exercises in patients with non specific low back pain and associated functional disability.

Study design:- Experimental study (Pre-test post-test matched pair design)

Setting:- Outpatient Physiotherapy clinic.

Population:- 30 patients with Nonspecific low back pain, aged between 18-40 years, were randomly assigned to two groups.

Material and Methodology:- 30 patients having Non specific low back pain (female, male) fulfilling the inclusion and exclusion criteria were recruited and were randomly allocated in two groups. Group A subjects were given Muscle energy technique and Group B subjects were given Pilates exercises. The subjects were assessed for Numeric Pain Rating Scale and Oswestry Disability Index prior to the treatment (1st day) and then reassessed after 1 week and then finally assessed after 2 weeks.

Data analysis: Data analysis was done by using SPSS version 11.0

Results: Significant changes were seen between and within both groups for NPRS and ODI ($p<o.o5$).For all parameters, Group 2 achieved the greater success after treatment ($p<0.05$).

Conclusion: Study proves that Pilates exercises given more significant results as compared to MET.

***Index terms*:- Non specific low back pain, Muscle Energy Technique, Pilates, Numeric Pain Rating Scale, Oswestry Disability index.**

I.INTRODUCTION:

According to national Institute of Arthritis and Musculoskeletal and Skin diseases, 8 out of 10 people have some type of backache. Disorders of low back are leading cause of disability in people younger than 45 years of age[1]. It has been estimated that mechanical disorders of spine, that is the problem of function and not pathology, represent at least 98% of low back pain[2].

Low back pain has been treated by variety of healthcare providers utilizing an array of treatment approaches. Over $30 billion in medical expenses per year are attributed to low back pain, which affects from 5% to 10% of adult population annually with the prevalence from 60% to 90% over a lifetime. Nonspecific low back pain occurs

in people with a wide variety of professionals, including those involving heavy labors, repetitive work activities and extended sedentary postures[3].

Exercise therapy designed to target key areas of back pain to increase individual's confidence in the use of their spine and to overcome the fear of physical activity[5]. Exercise therapy has been shown to more effective than usual care by a general practitioner (which includes staying active and taking analgesics as required) and just as effective as conventional physiotherapy. Furthermore it is more cost effective than the latter, as an exercise therapy program can be performed in groups[6]. However there are no recommendations of specific type of exercise to be undertaken and effectiveness of specific type of exercise therapy still need to be evaluated.

Back pain has been associated with dysfunction and weakness of "Core muscles" Core muscles components are antero-lateral and posterior. Antero-lateral core muscles include Rectus abdominis, internal and external oblique, transversus abdominis and diaphragm[7,8,9,10]. Together these muscles increase the intra-abdominal pressure thus imparting functional stability to lumbar spine. Lateral "Core muscles" includes multifidus, quadratus lumborum, psoas major, hip extensors, hip flexors and pelvic floor musculature. Pilates technique aim to specifically train all above mentioned "Core muscles" , sub maximally to increase tone and strength of these muscles, to lengthen and stretch lumbar spine thus decreasing compression of joints and cause an alteration in tilt of pelvis[11,12,13.] Support and stability to low back arise from the muscles mainly Iliopsoas and Quadratus lumborum. Biggest factor in low back pain is involvement of these muscles.

Another treatment approach for low back pain is Muscle Energy Technique of Iliopsoas and Quadratus lumborum. Greenman defined "MET" as manual medicine treatment procedure that involves the voluntary contraction of patient muscle in a precisely controlled direction, at varying level of intensity, against a distinctly executed counterforce applied by operator[3,12,13] . MET can be used to lengthen and strengthen muscles, to increase fluid mechanics and decrease local edema and mobilize restricted articulation.

While Muscle Energy Techniques and Pilates exercise have found an increased audience with clinicians, very little has been published in the peer reviewed literature on these interventions.

Objectives

To compare the effect of Muscle Energy Techniques and Pilates exercises in patients with non specific low back pain and associated functional disability.

II.MATERIAL AND METHODOLOGY:

The design of the study was Experimental study.. Ethical approval for the study was obtained from Institutional Review Board. Individuals with non specific low back pain were offered the chance to participate in this study via posters and letters given to local doctors clinics and via e-mailed information to staff and students at the local universities. Study was carried out at outpatient physiotherapy clinic by clinical professional therapist who is qualified physiotherapist registered with appropriate professional bodies who ensure the quality of clinical professional. Therapist is trained in Pilates and Muscle Energy Technique.

Participants

After volunteering to participate in the study and giving informed consent , 30 participants who had non specific low back pain for less than 12 weeks were randomly allocated to Muscle Energy Technique group and Pilates group by coin toss method according to eligibility criteria.(Fig:1)

Inclusion Criteria:

- Nonspecific low back pain of less than 12 week duration
- Age limit: 18-40 years
- Initial ODI scores: 30-60%
- Patient is otherwise medically fit to perform physical training

Exclusion Criteria:

- Patient already involve in Pilates exercises
- Major surgery within past year
- Motor weakness , absent or diminished muscle strength and reflexes

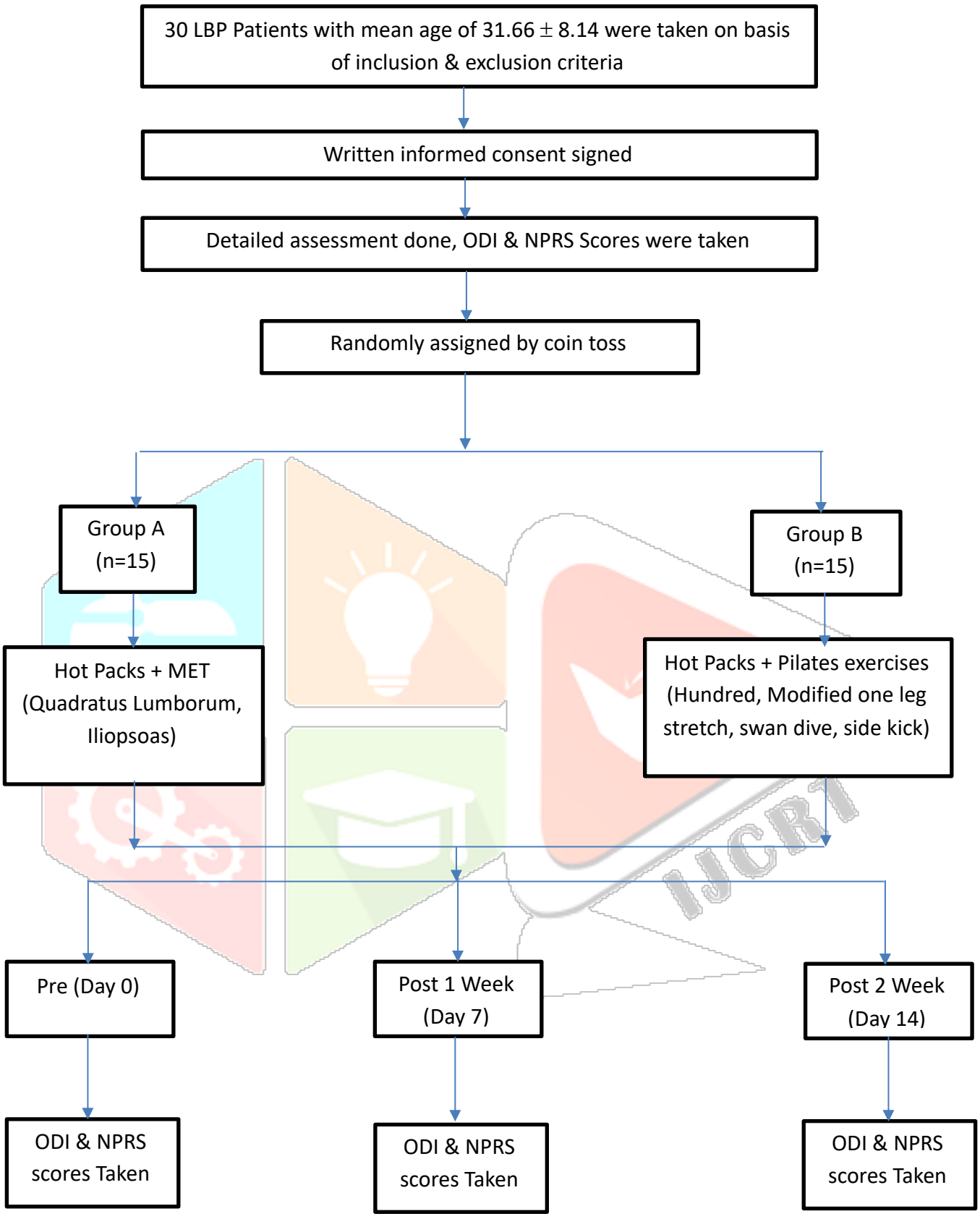


Figure 1 – Flow chart for enrollment and testing procedure

Intervention

Subjects in both groups attended 30 minutes session 5 days a week for 2 weeks. Patients were placed into either MET group or Pilates group. Patients were matched by initial ODI score according to categories originally described by Fairbank moderate (20-40%) and severe (40-60%).

Group A received Muscle Energy Technique and Group B received Pilates exercises for 2 weeks (5 days a week). Both groups intervention began with 20 minutes of moist heat with patient in supine recumbent position.

Group A- Muscle Energy Technique as described by Greenman for iliopsoas and quadratus lumborum (5 days a week for 2 weeks)[8]

Muscle Energy Technique for Iliopsoas-

- Position of patient: supine with buttocks at the end of couch and non treated leg fully flexed at hip and knee and held by patient
- Patient flexed at hip against resistance and hold it for 7-10 seconds
- Release the breathe on slowly ceasing contraction
- Inhale and exhale fully once more following cessation of all effort
- After release, a rapid stretch is applied to new barrier and held for 10 seconds
- Patient relaxed for 10 seconds and same procedure was repeated for 5 times

Muscle Energy Technique for Quadratus Lumborum-

- Position of patient: side lying with uppermost arm fully extended
- Position of therapist: behind the patient at waist level
- Inhale and abduct the uppermost leg and hold leg and breathe for 7-10 seconds allowing gravity to provide resistance
- Patient then hang leg behind him over the back of table
- Release breathe on slowly ceasing the contraction
- Therapist cradle the pelvis with both the hands to take out slack during exhalation
- Hold stretch for 10 seconds
- Relax for 20 seconds
- Repeat the same procedure for 5 times

Group B- Pilates exercises (5 Days a week for 2 weeks)[11]

Modified side kick:

- Position of patient: Side lying with legs straight, shoulders should be stacked one on top of the other, as should your hips
- Lightly support your head with your hand, making sure to lift your ribs away from the mat so that your back and neck stay in alignment
- The front hand rest firmly , palm down, on the mat in front of your chest
- Now move your top leg slowly forward and back to the centre
- Repeat the same for 5 times

Modified one leg stretch:

- Position for patient: crook lying position
- Ask the patient to inhale
- Exhale: pull your abs in, taking your belly button down towards your spine, as you curl your head and shoulders up to the tips of the shoulder blades . As you curl up, your left leg extend at a 45 -degree angle. At same time hold the right leg in knee to chest position.
- Repeat on the other leg
- Repeat this procedure for 5 times

The Hundred (base level modification): The Pilates hundred is a classic exercise that targets abdominal endurance and builds core strength.

- Position of patient: Crook lying position
- Ask the patient to inhale

- Exhale: Bring your head up with your chin down and using your abs, curl your upper spine up off the floor. Stay here and inhale
- Exhale: Extend your legs and arms towards the wall in front of you. Your legs should be as low as you can go without shaking and without the lower spine jumping up off the mat
- Hold your position
- Take 5 short breathes in and 5 short breathes out. While doing so, move your arm in a controlled up and down manner
- Do a cycle of 10 full breathes and then return to starting position
- Repeat the same for 5 times

Modified Swan Dive: Swan dive is Pilates exercises that strengthen the abdominals, gluteus, hamstrings, and inner thighs.

- Position of patient: Prone position (keep hands and forearm in contact with the floor)
- Engage your abdominal muscles, lifting your belly button up away from the mat
- Inhale: gently lengthen the thoracic spine allowing the upper part of the chest to lift off the floor
- Exhale: keep your abdominals lifted as you release the arc, lengthening your spine as your torso return to the mat in a sequential way: low belly, mid belly, low rib and so on
- Repeat the same procedure for 5 times

Outcome Measures:

Numeric Pain Rating Scale (NPRS)- Numeric Pain Rating scale is the most common used scale for assessing pain. NPRS is an 11-point scale ,ranged from 0-10. 0 is indicating "No Pain", and 10 is indicating "the worst pain " . The NPRS can be graphically or verbally delivered. A Value is selected by the patient itself that mostly describes the pain he/she has experienced over the past 24 hours.[16] The subjects were assessed for Numeric Pain Rating Scale prior to treatment (1st day) and then reassessed after 1 week and then finally assessed after 2 weeks. Childs JD et al. (2005) concluded NPRS to be valid, reliable, responsive outcome measure in patients with low back pain.[16]
Oswestry Disability Index: Subjects were also given Oswestry Low Back Pain Disability Questionnaire and were asked to answer all the questions by marking the statement that best describes their condition prior to the treatment (1st day) and then reassessed after 1 week and finally assessed after 2 weeks.[18] A decrease in Oswestry Disability Index is considered to be positive improvement . Reliability of this questionnaire is 0.99.[19]

III. DATA ANALYSIS AND RESULT:

Statistical package for the Social Sciences (SPSS) version 11 was used. Level of significance was set as $p<0.05$. Baseline demographic and clinical characteristics for each group has been explained. Baseline matching showed no significant difference between the groups. ($p>0.05$) Refer table-1.

Table 1: Subjects Characteristics in both groups A and B

GENERAL CHARACTERISTICS	GROUP A		GROUP B		COMPARISON	
	MEAN	SD	MEAN	SD	P-value	S
Age (in years)	32.14	7.35	33.26	7.33	0.54	NS
Weight(in kg)	66	8.61	63.2	7.41	0.46	NS
Height (in cm)	168.5	6.67	170.8	8.55	0.39	NS
BMI %	23.17	1.99	21.62	1.40	0.40	NS
Pre ODI %	43	5.58	42.86	6.20	0.87	NS
Pre NPRS	8.07	0.80	7.87	0.83	0.51	NS

*SD: Standard Deviation, P: Probability,
*S: Significant, NS: Non-Significant

Within the group:-

Group A (Received Muscle Energy Technique):-

The mean numeric pain rating scale scores (NPRS) of the experimental group 1(Group A) at day 0, day 7 and day 14 were analyzed using paired t-test. The analysis revealed a significant reduction in the NPRS scores within the group over the study duration. ($p<0.05$) Refer table-2

The mean Oswestry Disability index scores of the Experimental Group 1(Group A) at day 0, day 7 and day 14 were analyzed using paired t-test. The analysis revealed a significant reduction in the ODI scores within the group over the study duration. ($p<0.05$) Refer table-2

Table-2: Group A (received muscle energy technique) paired sample t-test

		Mean	N	Std. deviation	Std. error Mean
Pair 1	PRE_ODI	42.53	15	5.579	1.440
	POST ODI After 2 wk	12.80	15	4.945	1.277
Pair 2	PRE NPRS	8.07	15	0.799	0.206
	POST NPRS After 2 wk	4.07	15	0.704	0.182

		Paired differences					T	Df	Sig.(2 tailed)
		Mean	Std. deviation	Std. error mean	95% Confidence interval of the difference				
					lower	upper			
Pair 1	PRE ODI POST ODI Aft.2 wk	29.73	5.800	1.498	26.52	32.95	19.855	14	0.001
Pair 2	PRE NPRS POST NPRS Aft 2 wk	4.00	1.069	.276	3.41	4.59	14.491	14	0.001

Group B (Received Pilates exercises) :-

The mean Numeric pain rating scale scores of the experimental group 2(Group B) at day 0,day 7 and day 14 were analyzed using paired t-test. The analysis revealed a significant reduction in NPRS scores within the group over the study duration. ($p<0.05$) Refer table-3

The mean Oswestry disability index scores of the experimental group 2(Group B) at day 0, day 7 and day 14 were analyzed using paired t-test. The analysis revealed a significant reduction in ODI scores within the Group over the study duration. ($p<0.05$) Refer table-3

Table-3: Group B (received Pilates exercises) paired sample t-test:

		Mean	N	Std. deviation	Std. error Mean
Pair 1	PRE ODI	42.87	15	6.198	1.600
	POST ODI After 2 wk	7.73	15	3.011	0.777
Pair 2	PRE NPRS	7.87	15	0.834	0.215
	POST NPRS After 2 wk	2.47	15	0.640	0.165

Paired sample test:

		Paired differences					T	Df	Sig.(2-tailed)
		Mean	Std. deviation	Std. error mean	95% Confidence interval of the difference				
					lower	upper			
Pair 1	PRE ODI POST ODI Aft.2 wk	35.13	6.424	1.659	31.58	38.69	21.182	14	0.001
Pair 2	PRE NPRS POST NPRS after 2 wk	5.40	.737	.190	4.99	5.81	28.386	14	0.001

Between the groups:-
Post ODI and NPRS scores means of group B (who received Pilates exercises) after 1 week showed more significant reduction in pain and more improvement in disability as compared to group A and also group B again showed more significant results after 2 weeks as compared to group A. Refer table-4

COMPARISON OF NPRS AND ODI SCORES BETWEEN GROUP A (MET) AND GROUP B (PILATES EXERCISES)

Table-4: Mean, standard deviation and standard error of mean of subjects before and after the treatment

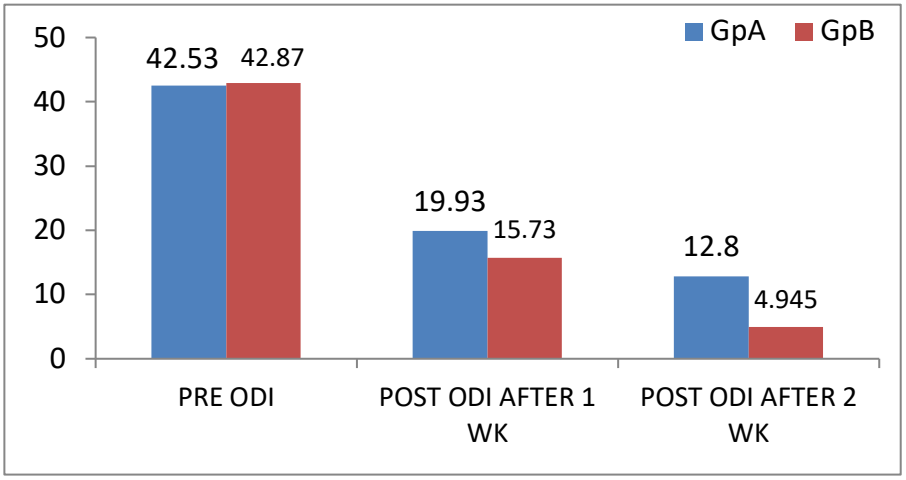
	GP	N	Mean	Std. deviation	Std. error mean
PRE ODI	1	15	42.53	5.579	1.440
	2	15	42.87	6.198	1.600
POST ODI after 1 wk	1	15	19.93	8.146	2.103
	2	15	15.73	5.063	1.307
POST ODI After 2 wk	1	15	12.80	4.945	1.277
	2	15	7.73	3.011	0.777
PRE NPRS	1	15	8.07	0.799	0.203
	2	15	7.87	0.834	0.215
POST NPRS After 1 wk	1	15	5.73	0.961	0.248
	2	15	4.60	0.828	0.214
POST NPRS After 2 wk	1	15	4.07	0.704	0.182
	2	15	2.47	0.640	0.165

NPRS and ODI scores of Groups A and B were analyzed using levene's test for equality of variance and t-test for equality of means. The analysis revealed a significant difference in NPRS and ODI scores between the two groups. NPRS showed a more significant results. Refer table-5

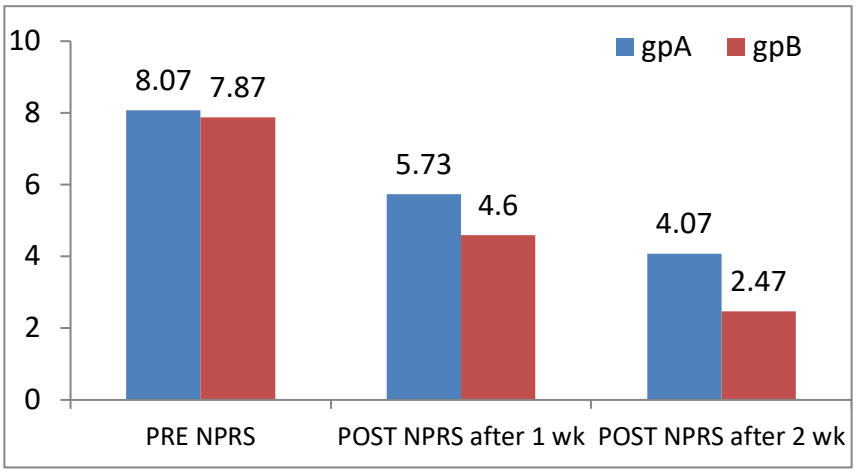
TABLE-5: Levene's test for equality of variance and t-test for equality of means

		Levene's Test	T-Test							
		F	Sig.	T	df	Sig.(2 tailed)	Mean diff	Std. error diff	95% confidence interval	
	Equal variances								Lower	Upper
Pre ODI	Assumed	0.097	0.758	-0.16	28	0.878	-0.33	2.153	-4.744	4.077
	Not assumed			-0.16	27.696	0.878	-0.33	2.153	-4.746	4.079
Post ODI after 1 wk	Assumed	0.572	0.456	1.696	28	0.101	4.20	2.476	-0.873	9.273
	Not assumed			1.696	23.414	0.103	4.20	2.476	-0.918	9.318
Post ODI After 2 wk	Assumed	1.237	0.276	3.389	28	0.002	5.07	1.495	2.004	8.129
	Not assumed			3.389	23.126	0.003	5.07	1.495	1.975	8.158
Pre NPRS	Assumed	0.188	0.668	0.671	28	0.508	0.20	0.298	-0.411	0.811
	Not assumed			0.671	27.949	0.508	0.20	0.298	-0.411	0.811
Post NPRS after 1 wk	Assumed	0.615	0.440	3.460	28	0.002	1.13	0.328	0.462	1.804
	Not assumed			3.460	27.400	0.002	1.13	0.328	0.462	1.805
Post NPRS after 2 wk	Assumed	0.191	0.665	6.515	28	0.001	1.60	0.246	1.097	2.103
	Not assumed			6.515	27.751	0.001	1.60	0.246	1.097	2.103

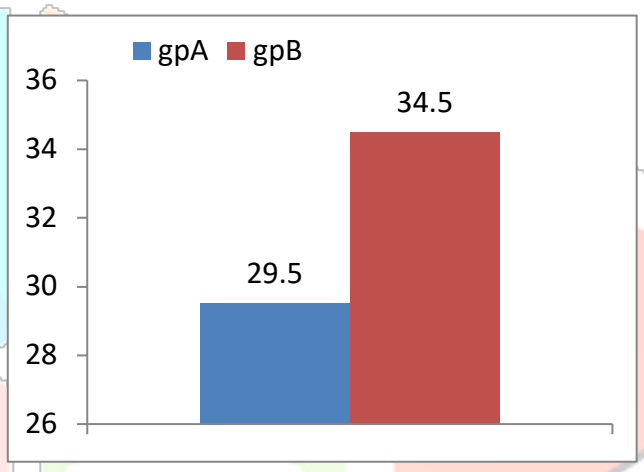
The preliminary data obtained from the study thus shows that there is significant difference with the Muscle Energy Technique and Pilates exercises in reducing non specific low back pain and improving functional disability. Pilates (Group B) showed a more significant difference in reducing pain and improving functional disability in patients with non specific low back pain as compared to Muscle Energy Technique.



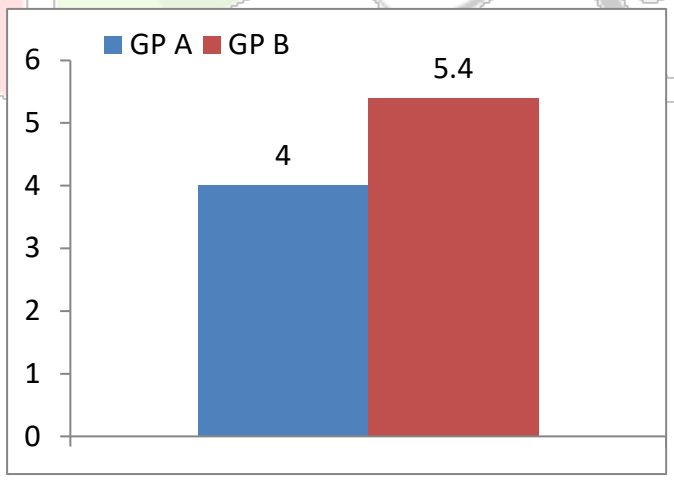
Graph -1: Showing Mean & S.D of ODI Scores in Gp A & B on day 0, day 7 & day 14.



Graph -2: Showing Mean and SD of NPRS scores in Gp A & B on day 0,day 7 & day 14.



Graph -3: Showing Mean and SD of Reduction in ODI Scores in gp A & B for study duration



Graph -4: Showing Mean and SD of Reduction in NPRS Scores in gp A & B for study duration

IV.DISCUSSION:

The findings from present study indicate that a program of modified Pilates exercises can help to decrease pain as assessed by numeric pain rating scale and improve functional disability as assessed by Oswestry disability index in individuals with non specific low back pain of less than 3 months with no radiating symptom to a greater extent than those individuals who received Muscle energy technique. Furthermore Pilates exercise can improve overall general health and increase proprioceptive balance and flexibility in participants with non specific low back pain. This improvements are observed despite the study be performed on already active individuals, indicating that specificity of Pilates is important.

It appears from the result of the present study, that there was significant reduction in the NPRS and ODI scores in both experimental groups after 2weeks. Another important observation was that there was more reduction in NPRS and ODI scores in Group B after 1st and 2nd weeks as compared to group A.

Both experiment Groups received hot packs for 20 minutes prior to the treatment (MET and Pilates exercises). French et al demonstrated that the application of hot packs prior to treatment increases pain threshold. The proposed mechanism of this effect include direct and immediate reduction of pain by activation of spinal gating mechanism and indirect later and more prolonged reduction of pain by reduction of ischemia and muscle spasm. Nerve firing rate has also been found to change in response to changes in temperature. Elevation of muscle temperature to 42 ^{0}celsius has been shown to result in a decreased firing rate of type II muscle spindle efferent and gamma efferent and an increased firing rate of type I b fibers from golgi tendon organs. These change in nerve firing rates are thought to contribute to a reduction in firing rate of alpha motor neurons thus to reduction in muscle spasm[30].

Group A (muscle Energy technique) showed significant improvement ($p<0.05$) in terms of reduction in NPRS and ODI scores . Previous work has demonstrated that weakness and atrophy of "'core muscles '' and shortening of postural muscles (iliopsoas and quadratus lumborum) is usually present in patient with nonspecific low back pain. However more recently ,it has been proposed that this is caused by impaired motor control rather than lack of use leading to abnormal spine movements caused by decreased proprioception and a decrease in precision of muscles coordination .When this 'lateral corset ' i.e. Iliopsoas and a quadratus lumborum become unstable , the pelvis is held in increased elevation ,accentuated when walking, resulting in L5-S1 stress in sagittal plane and this result in low back pain[3,8,12,14] .

Sandra Yale (1991), Di Giovanna (1991) mentioned that when muscle is isometrically contracted , its antagonist will be inhibited and will relax immediately following this. In post-isometric relaxation , sustained contraction of agonist muscle stimulate the golgi tendon organs in tendon of muscle, since their response to such a contraction seem to be to set the tendon and muscle to a new length by inhibiting it. Thus this reduces the tension in the postural muscles, hence reduces the pain as assessed by NPRS scores and improves the disability as assessed by ODI scores in patients with non specific low back pain[13] .

Group B (Pilates exercises) also showed significant reduction in the NPRS and ODI scores. Also on comparing the two groups , Group B showed more significant results. The above results can be well explained when considering the mechanisms involved in LBP.

The instability in spinal motion segments and the dysfunction in the muscular control system of the spine have been suggested as important predisposing factors of LBP (Kirkaldy- Willis and Farfan 1982, Friberg 1987 , Panjabi et al 1989)[13,14,15] . The main muscles responsible for stabilization are the transversus abdominis muscle and multifidus (Hodges 1999, Panjabi et al 1989) [13] . The concept of stabilization of the spine through the activation of the transversus abdominis muscle together with multifidus is central to Pilates (Anderson 2000)[20].

The other principles that apply directly to Pilates namely , lateral costal diaphragm breathing, activation of the pelvic floor and correct alignment of the spine have also been documented as effective techniques for stabilization of the spine without global muscular activation (O'Sullivan 2000, Hodges 1999)[6] . It is therefore understandable that with increased stabilization achieved through Pilates there is a decrease in spinal instability and a decrease in pain.

The Philadelphia panel(2001) also recommend that an effective exercise program for LBP should include stretching, strengthening and mobility exercises. Pilates fulfills the above criteria while applying the principles of stabilization, hence the effectiveness of the intervention employed in this study in reducing patient pain and improving disability[23].

It should be noted that Muscle energy technique produced good outcomes, but Pilates group improved the outcome substantially. The Pilates group's mean post-treatment score represents an Oswestry Questionnaire with minimum of 6 out of 10 questions scored as "no pain" . Most patients can return to pre injury occupational activities with scores as high as 10% to 12%. only 5 subjects in the Pilates group had scores in this range with all other scores falling between 4% to 8%. Moreover , the difference between each patient's pre and post-treatment Oswestry scores more than exceeded the 6-point minimum clinically important difference as described as fritz and Irrang[18].

The Pilates used in the current study is likely to be beneficial for back pain as it uses functional static-dynamic resistance exercise to aid "core muscles" strengthening and endurance and to improve sensory motor control of the trunk and additional limb movement. Pilates is a whole body exercise that seems to encompass biological, educational and psychological aspects including coping strategies and social components, all of which are important factors in improving back pain.

Clinical Implication

The clinical relevance of this study lies in the fact that the mobilizations and various electrotherapeutic modalities have shown to be effective in low back pain patients but there are no recommendations of specific type of exercises to be undertaken for strengthening and stretching of core and pelvic muscles in low back pain and effectiveness of specific type of exercises still need to be evaluated. Also both Pilates and muscle energy technique are more cost effective and less time consuming. MET and Pilates are designed to target the key areas of back pain , to increase the individual confidence in the use of their spine and to overcome the fear of physical activity. In India, where the focus of health care seems to be in the primary health care setting, this study shows the benefit that Pilates in the form of group classes may have in reaching the large number of patients who may not normally have access to any type of management of LBP. Classes would be more financially viable and could also be run in the occupational or community setting, where the focus may also be turned to prevention of initial and further injuries.

Limitation of Study

- Small sample size therefore the study could not be generalized.
- Only the immediate effects of Pilates exercises and Muscle energy technique were measured, with no attempt made to determine whether absence of pain was maintained over time.
- The duration of study was small.
- Subjective parameters were used.

Future Research

- Large sample size can be used for future studies.
- Patients with higher level of disability as assessed by ODI may be taken.
- Chronic nonspecific low back pain patients(more than 3 months) may be taken.
- A Quality of life assessment can be included into a further study on the effectiveness of MET and Pilates as a treatment for non specific low back pain. A Questionnaire such as SF-36 questionnaire can be used.

V.CONCLUSION:

The preliminary data obtained from the study shows that there is a significant difference with Pilates and Muscle Energy Technique in reducing non specific low back and improving functional disability. Additionally Pilates give more significant results as compared to Muscle Energy Technique.

VI.AUTHORS CONTRIBUTION

All authors conceptualized the study and participated in the study screening, selection and manuscript preparation. All authors provided intellectual content and approved the manuscript for publication.

VII.CONFLICT OF INTEREST STATEMENT

No conflicts declared

VIII.FUNDING

The authors have nothing to disclose

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