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Original Article

EFFICACY OF ACTIVE STRETCHING OVER PASSIVE STRETCHING ON THE FUNCTIONAL OUTCOME AMONG PATIENTS WITH MECHANICAL LOW BACK PAIN

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ABSTRACT

Introduction: Low back pain has a significant impact on the individual's family, socio-economic status, occupation, health system, community. Stretching is included as a part of treatment regimen for low back pain. Much controversy exists on the type of stretching technique and parameters which would prove beneficial to improve flexibility. Aim of the study was to compare the efficacy of active stretching over passive stretching, on the functional performance among patients with low back pain.
Materials and method: 52 subjects with mechanical low back pains in the age group of 20-50 were enrolled for the study. Flexibility measurement and Oswestry Low Back Pain Disability Index was used as the primary outcome measure. Flexibility of Iliopsoas was measured using the modified Thomas test; Flexibility of Hamstring was measured using the active knee extension test. The subjects underwent 7 days of therapy sessions, after 7 days of therapy the individuals where re-assessed for flexibility and they were asked to fill the Oswestry Low Back Pain Disability Questionnaire.
Results: 52 subjects were enrolled in the study, of which 36 subjects completed the study, among them 18 subjects in the control group and 18 subjects in intervention group. For independent groups paired t-test was used. Using the paired sample t-test significant difference was measured between the pre and post of the intervention group and control groups a significant difference of .001 was achieved in both the groups (P=.001).
Discussion: The results of the present study prove that both active and passive stretching is beneficial in improving the flexibility of tight muscles in the lower limbs. Also both active stretching and passive stretching has a profound effect on the functional aspect in patients suffering with low back pain.
Conclusion: The result of present study conveys that both active and passive stretch is helpful in improving the flexibility in the major muscle groups of lower extremity. Scope for further studies is open with a larger sample size, homogenous parameters of treatment.
KEYWORDS: Active Stretching, Passive Stretching, Iliopsoas, Hamstring, Functional Outcome.

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INTRODUCTION

Humans are unique compared to other primates in the way we walk and stand. The alteration made in the spine and pelvis gives us stability while we walk and stand but left us vulnerable to low back strains and sprains.

Low back pain is neither a disease nor a diagnostic entity of any sort. The term refers to pain of variable duration in an area of the anatomy afflicted so often that it is has become a paradigm of responses to external and internal stimuli[1].

Low back pain affects the quality of life, interferes with work performance and is a common cause of disability. Acute low back pain is the most common form and is usually self-limiting, less than three months regardless to the treatment received. Chronic low back pain is a more complex problem where the psychology of the person is affected and is usually more than twelve weeks or three months [1].

In most of the western countries musculoskeletal disorders (MSDs) especially low back pain are the common reasons why employees are absent from work than from other groups of disease [2,3,4,5].

In the United States back pain accounts to be the most common reason for claims of workers compensation filings, which makes up one fourth of the claims [6,7]. Back pain is second to common cold as the most frequent cause of sick leave which results in 40% absence of work [8]. In the United States an estimate of $50 to $100 billion was spent on back pain during the year 1990 [9]. In Australia the direct and indirect expense of low back pain was estimated to be $9.17 billion in the year 2001[18]. Incidence and Prevalence: - The incidence of low back pain is problematic as the onset is high by early adulthood [10]. The incidence of people who have had first-ever episode of low back pain in the age range of 30-60 are, incidence-6.3% [11]. The incidence of people who have had first-ever episode of low back pain in the age range of 18-75 are, incidence- 15.4%, standard error 0.9% [12]. The incidence of people who have had first-ever or recurrent episodes of back pain in the age range of 20-69 are 18.9%, [13]. The incidence of people who have had first-ever or recurrent episodes of back pain in the age range 18-75 are incidence-36.0% [12]. The prevalence of low back pain in Australia in the age group of 18-99 years is 25.6% [14]. The prevalence of low back pain in Saskatchewan adults in the age group of 20-69 years is 28.7% [15]. The prevalence of low back pain in Jamu in the age groups of 15-99 years is 8.4% [16]. Causes:-Low back pain can arise due to injury of any of the anatomical structures like ligaments, muscle, intervertebral discs, bones, neural structures, blood vessels and joints [17]. In few instances low back pain occurs due to osteoporotic fractures, infection or neoplasm [17]. Low back pain and its impact:-Low back pain has a significant impact on the individual's family, socio-economic status, occupation, health system, community [24].

According to National Health Survey (NHIS) in a one-year period about 22.4 million back pain cases lasted a week or more (prevalence: 17.6%), these cases where estimated to cost a total of 149 million lost workdays [19].

Managing a low back pain is very challenging for physiotherapists. Various factors influence patients including the psychology and the individual's pain response. During the world war II various investigations on the influence of pain has begun, Breecher observed that soldiers injured from a fierce battle requested significantly less amount of morphine compared to the civilian people with the similar injury.

Treatment of low back is individually tailored and depends on the physical therapy assessment of the same. The common therapeutic measures are exercise, electrotherapeutic modalities and spinal manipulations. The recent trends of management are a multidisciplinary approach. Exercise is considered effective in management of low back pain [20,23].

According to Dr. Vladimir Janda balance is necessary between the agonist and the antagonist for normal movement and function. Muscle imbalance occurs when there is mismatch between the length and strength between the agonist and the antagonist eg; hamstring tightness may limit full ROM and force of knee extension. Janda observed that the static or postural muscles have a tendency to tighten where as the dynamic or phasic muscles tend to weaken. Muscle imbalance often arises after injury or pathology or from abnormal proprioceptive input as a result of abnormal joint positioning. Muscle imbalance is an example of functional pathology where abnormal length and strength in the agonist and antagonist leads to abnormal joint function. Tightness of antagonists subsequently inhibits agonists based on Sherrington's law of reciprocal inhibition (Sherrington 1906). Janda observed tightness in the muscles which maintained single leg stance. In the lower quarter the muscles which are prone

to tightness are the iliopsoas, quadrates lumborum, thoracolumbar paraspinals, piriformis, rectus femoris, TFL- IT band, hip adductors, triceps surae (particularly soleus), tibialis posterior. Witvrouw and colleagues (2003) found that professional soccer players with hamstring or quadriceps tightness were at a higher risk of lower extremity injuries, as compared to players with tight plantar flexors or hip adductors.

Active stretching is a type of dynamic stretching [25], Definition given by Murphy (1994), dynamic stretching consists of performing movements that take the limb through range of motion (ROM) by contracting the agonist muscles, which allows the antagonist muscles to relax and elongate due to reciprocal inhibition. According to Sahrmann's movement systems approach, active stretching is meaning to improve flexibility of tight muscles while concomitantly improving the functional performance of the antagonist.

According to the study conducted by Michael V Winters et al (September 2004), both active and passive stretching helps to improve the ROM by improving the flexibility of tight hip flexors in young patients with low back pain and lower extremity complaints [27].

In the present scenario treatment options available to treat flexibility are enormous, debate exist which is most efficient. The purpose of the present study was to analyze whether active stretching is superior to passive stretching in improving the functional outcome in patients with mechanical low back pain.

MATERIAL AND METHODS

STUDY DESIGN

Randomized controlled trial: 52 subjects with mechanical low back pains in the age group of 20-50 were enrolled for the study. The sample size was estimated by using F test- ANOVA with power .99. The source of study population was Out Patient Department Faculty of Physiotherapy, Sri Ramachandra University, Porur, Chennai, India.

Prior to commencement of the study ethical clearance was obtained from the Institutional Ethics Committee (IEC) of Ramachandra University, Porur, Chennai, India.

Inclusion criteria: Mechanical low back pain, severity of pain less than 8 on VAS scale, tightness of iliopsoas or hamstring.

Exclusion criteria: Radiating pain, previous spinal surgeries, vertebral column infection, previous spinal fracture, spondylolisthesis.

The subjects who met the inclusion criteria formed the study population (n=52). Informed consent in the native language was obtained prior to the study. The subjects were initially evaluated using musculoskeletal assessment in order to detect deficit in flexibility of iliopsoas and hamstring muscle. Neurological screening was performed to eliminate involvement of nerve. The patients were asked to fill the Oswestry Low Back Pain Disability Questionnaire prior to the intervention.

Flexibility of Iliopsoas was measured using the modified Thomas test [26]. Subjects were asked to lie on the edge of the couch and were asked to bend both legs towards his or her chest this was done to flatten the lumbar spine, and had to leave one leg towards the ground and was asked to maintain the other leg in the same position, the goniometer axis was placed on the greater trocanter the stationary arm was placed in the line of the trunk and the movable arm in line of the femur (Fig:1,2). Subjects were classified to have tight hip flexors if the thigh was above 0 degree in relation to treatment table [26,27].

Iliopsoas flexibility measurement

Fig. 1: Start position. **Fig. 2:** Final position.

Flexibility of Hamstring was measured using the active knee extension test [28,32,38], the subject was asked to assume a supine posture the subjects hip and knee was brought to 90 degrees of flexion from there the leg was asked to actively extended the leg till a stretch was felt. The goniometer axis was placed on the lateral epicondyle of the femur the stationary

arm in line with femur and the movable arm in line with tibia (Fig:3,4). Under normal circumstances hamstring should be 20 degrees short of extension of knee, in order to be called flexible [29].

Hamstring flexibility measurement:

Fig. 3: Starting position. **Fig. 4:** Final position.


Interventions:

After the initial screening subjects were randomly assigned using simple randomization method into Intervention and Control groups.

The Intervention group received Active stretching for Hip flexors and Hamstring.

In order to stretch the hip flexors actively the subject was asked to assume a prone position and a pillow was placed under the pelvis and abdomen according to the needs of the individual, the subject was asked to actively extend the leg by relax his hamstring and by squeezing his or her gluteal muscle. The knee was maintained in extension, the knee was bent to 90degrees if the individual was unable to perform hip extension with the knee extended. The patient was asked to maintain knee extension when he or she was able to perform hip extension with knee extended (Fig.:5,6) [27].

Active stretch of Iliopsoas

Fig. 5: With knee extended.

Fig. 6: With knee flexed.

In order to stretch the hamstring the subject was asked to assume a supine position with the hips and knees flexed to 90 degree, the individual was asked to grasp below the knee with two hands and was asked to actively extend the leg by contracting the Quadriceps muscle till a stretch is felt on the posterior thigh [30]. (Fig 7,8) The subjects were asked to hold the limb in the stretched position for 10 seconds and repeat it for 10 times [27].

Active stretching of hamstring

Fig. 7: Start point. **Fig. 8:** Final position.


The Control group subjects received passive stretching for Hip flexors and Hamstring.

To stretch the hip flexors passively the individual was asked to assume a prone posture and a pillow was placed under the abdomen according to the needs of the patient. The therapist placed one hand and stabilized the pelvis with the other hand he passively lifted the thigh off the couch till a stretch felt on the anterior thigh (Fig:9) [31].

Fig. 9: Passive stretching of Iliopsoas.

To stretch the hamstring the subject was asked to assume a supine position and his or her hip and knee was bent to 90 degrees from that position the therapist passively extended the leg till a stretch was felt on posterior thigh (Fig:10) [32].The stretch position is held for 60 sec and repeated for 4 times [31,33].

Fig. 10: Passive stretching of hamstring.

Data Analysis

The collected data was analysed with SPSS 16.0 version. To describe about the data descriptive statistics frequency, percentage, means and S.D were used. To find the significance difference between the bivariate samples in Paired groups (Pre & Post) Paried sample t-test was used & for Independent groups (A & P) Independent t-test was used. In both the above statistical tools the probability value P=.05 is considered as significant level.

RESULTS

Table 1: Group statistics.

Muscles being tested	Groups	Sample size-n	Mean	Std. Deviation
ILIOPSOAS PRE R	Intervention	18	7.06	3.472
	Control	18	6.56	4.003
ILIOPSOAS POST R	Intervention	18	2.33	2.301
	Control	18	2.72	2.539
ILIOPSOAS PRE L	Intervention	18	6.5	2.407
	Control	18	7.06	4.331
ILIOPSOAS POST L	Intervention	18	2.61	2.429
	Control	18	3.61	3.109
HAMSTRING PRE R	Intervention	18	29.22	10.429
	Control	18	33.06	10.702
HAMSTRING POST R	Intervention	18	11.28	4.184
	Control	18	17.33	6.174
HAMSTRING PRE L	Intervention	18	27.67	8.99
	Control	18	29.33	9.549
HAMSTRING POST L	Intervention	18	12.67	5.391
	Control	18	16.39	6.409
OSWESTRY PRE	Intervention	18	26.39	12.857
	Control	18	29.44	14.313
OSWESTRY POST	Intervention	18	9.83	7.95
	Control	18	13.89	8.697
PERCENTAGE	Intervention	18	15.56	10.048
	Control	18	15.06	11.815

52 subjects were enrolled in the study, of which 36 subjects completed the study. 18 subjects in the control group (mean age= 34.94 years, SD= 8.822) and 18 subjects in intervention group (mean age=35. 33 years, SD=7.904). 16 drop outs due to lack of follow up. 6 drop out in intervention and 10 drop out in control group.

The percentage of difference in the Oswestry Disability Index comparing the pre and post of intervention and control group is, for intervention group 15.56 (mean) and 10.048 (SD), for control group 15.06 (mean) and 11.815 (SD).The data obtained at baseline were homogenous for both groups. For independent groups paired t-test was used, there were no significant change in Iliopsoas Pre R, Iliopsoas Post R, Iliopsoas Pre L, Iliopsoas Post L, Hamstring Pre R, Hamstring Pre L, Hamstring Post L, Oswestry Pre, Oswestry Post for both intervention and control group. There was significant difference among the post of Hamstring for right side. Using the paired sample t-test significant difference was measured between the pre and post of the intervention group and control groups a significant difference of .001 was achieved in both the groups (P=.001)

Table 2: Independent T-Test

Groups	t	P-Value
ILIOPSOAS PRE R	0.4	0.691 #
ILIOPSOAS POST R	-0.481	0.633#
ILIOPSOAS PRE L	-0.476	0.637#
ILIOPSOAS POST L	-1.075	0.289#
HAMSTRING PRE R	-1.088	0.284#
HAMSTRING POST R	-3.445	0.00153*
HAMSTRING PRE L	-0.539	0.593#
HAMSTRING POST L	-1.886	0.0679#
OSWESTRY PRE	-0.674	0.504#
OSWESTRY POST	-1.46	0.153#
PERCENTAGE	0.137	0.892#

No significant at P <.05 level
* Significant at P < .05 level

Table 3: Bivariate comparison using Paired Sample T-Test.

A. Active Stretching Group:

Pairs	Groups	Mean	Std. Deviation	t-value	P-Value
Pair 1	ILIOPSOAS PRE R	7.06	3.472	8.825	.0001**
	ILIOPSOAS POST R	2.33	2.301		
Pair 2	ILIOPSOAS PRE L	6.5	2.407	10.525	.0001**
	ILIOPSOAS POST L	2.61	2.429		
Pair 3	HAMSTRING PRE R	29.22	10.429	8.969	.0001**
	HAMSTRING POST R	11.28	4.184		
Pair 4	HAMSTRING PRE L	27.67	8.99	8.727	.0001**
	HAMSTRING POST L	12.67	5.391		
Pair 5	OSWESTRY PRE	26.39	12.857	7.364	.0001**
	OSWESTRY POST	9.83	7.95		

** Highly Significant at P < .01 level

B. Passive Stretching Group:

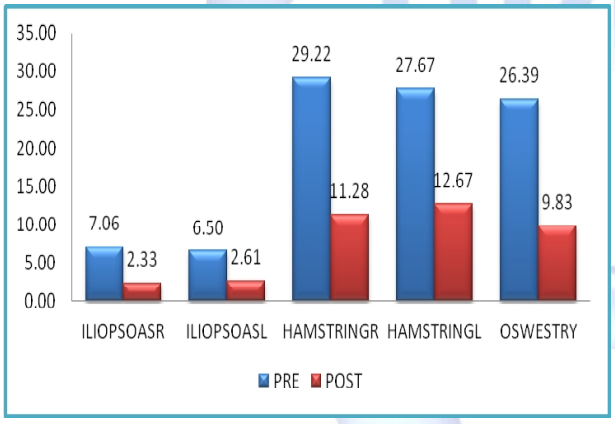
Pairs	Groups	Mean	Std. Deviation	t-Value	P-Value
Pair 1	ILIOPSOAS PRE R	6.56	4.003	6.01	0.0001**
	ILIOPSOAS POST R	2.72	2.539		
Pair 2	ILIOPSOAS PRE L	7.06	4.331	6.481	0.0001**
	ILIOPSOAS POST L	3.61	3.109		
Pair 3	HAMSTRING PRE R	33.06	10.702	9.211	0.0001**
	HAMSTRING POST R	17.33	6.174		
Pair 4	HAMSTRING PRE L	29.33	9.549	7.208	0.0001**
	HAMSTRING POST L	16.39	6.409		
Pair 5	OSWESTRY PRE	29.44	14.313	5.397	0.0001**
	OSWESTRY POST	13.89	8.697		

** Highly Significant at P < .01 level

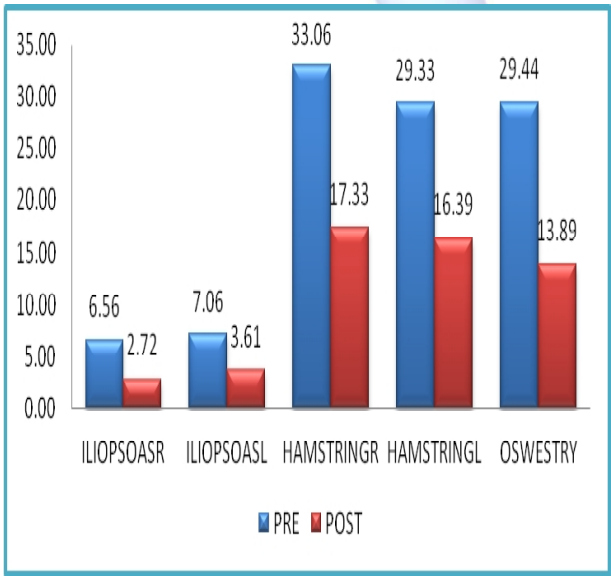
Table 4: The Mean of Post Treatment for Intervention and Control group.

Groups	ILIOPSOAS R	ILIOPSOAS L	HAMSTRING R	HAMSTRING L	OSWESTRY POST
Post Intervention group	2.33	2.61	11.28	12.67	9.83
Post control group	2.72	3.61	17.33	16.39	13.89

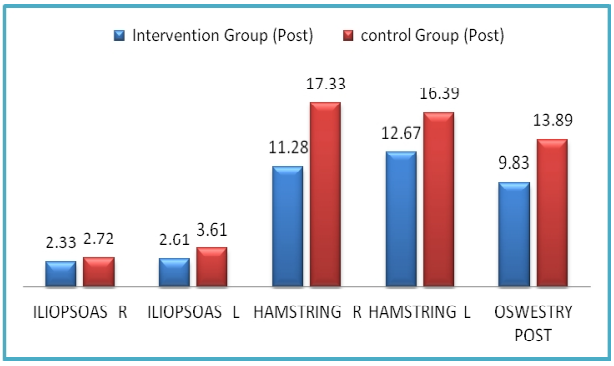
Graph 1: Mean of variables Intervention Group:



Graph 2: Mean variables Control Group:



Graph 3: Mean of variables- post intervention:



DISCUSSION

Low back pain is a common cause of disability in almost all the populations through the world, the causes of low back pain are multifactorial [1]. A multidisciplinary approach is the most recent method used to manage low back pain. A limited flexibility of muscles predisposes the individual to musculoskeletal injuries and limits the person's functional status [39]. Decreased flexibility of the muscles of the lower extremity may lead to stress fractures, muscle strain; patello femoral pain syndrome [40], Hamstring muscle is commonly reported to be the most injured multijoint muscle in the body [41].

In the present study 56 subjects with history of low back pain of mechanical origin were included. 36 subjects formed the study sample. Due to lack of follow up there were 16 drop outs.

There was clinically and statistically significant difference in both intervention and control group. However there was no statistical significance for the post intervention of right and the left Iliopsoas and the left hamstring in between the groups. There was statistical significance for the right side post treatment hamstring in between the groups. The data obtained at baseline were homogenous for both groups.

Oswestry Disability Index scores were statistically significant when compared to the baseline in both intervention and control group, however there was statistically no significant difference in between the groups post intervention. Meade et al cites 4 points as the minimum difference in mean scores between the groups which showed clinical significance. The United States Food and Drug Administration (US FDA) states that a minimum of 15 point change for patients before undergo spine fusion surgery

and at follow up. The percentage of change achieved was higher in intervention group than compared to control group, however there was no statistical significance between both the groups.

In a study done by (Kopec 1995) the frequency distribution of disability score was measured on 242 ambulatory low back pain patients, they concluded that 13.2 percent respondents scored 0-10 percent disability. 21.1 percent respondents scored 10-20 percent disability 17.4 percent responded 20-30 percent disability. 22.3 percent respondents scored 30- 40 percent disability. 12.8 percent responded 40-50 percent disability. 8.3 percent responded 50-60 percent disability. 3.7 percent responded 60-70 percent disability, .08percent responded 70-80 percent disability, 0.0 percent responded 80-90 percent disability and 0.4 percent responded 90-100 percent disability. The findings of the present study in pre intervention go in accordance with the study by Kopec. The respondents for the pre intervention for intervention group were, 2 for 0- 10 percent disability, 4 for 10-20 percent disability, 6 for 20-30 percent disability, 5 for 30-40 percent disability, 40-50 and 50-60 percent disability were zero number, 1for 60-70 percent disability, 70-80, 80-90, 90-100 percent disability were zero number. For control group were 0-10 percent disability were zero number, 4 for 10-20 percent disability, 8 for 20-30 percent disability, 4 for 30-40 percent disability, 1 for 40-50 percent disability, 50-60, 60-70 percent disability were zero number, 1 for 70-80 percent disability, 80-90 and 90-100 percent disability were zero number. By knowing the percent of disability it helps us to understand the level of function of the patient, in the present study in the intervention and control group majority of the subjects were moderately disabled. Post intervention most of the subjects scored below 20% disability (minimally disabled) for both the intervention and control group.

In a study done by James Stephens et al, they used the "awareness through movement" (ATM) to stretch the hamstring which had no component of passive stretching, with a sample size of 38 subjects. "Awareness through movement was defined as the process of verbally guiding the individual to perform the movements slowly and gently through any activity". They used the active knee extension test to measure the length of hamstring pre and post treatment. The results suggested that subjects in the ATM group improved in their flexibility with a high statistical significance ($+7.04^0$) than compared to a control group which did not receive any treatment ($+1.15^0$) [30]. In the present study and the study by James Stephens et al the hamstring flexibility was measured by using the active knee test. Active knee extension test involved the individual to move the extremity to the limit which is possible by him or her, where as passive knee extension test involved the examiner passively taking the limb to a maximally stretched position to the ranges the individual actively will not be able to perform actively, compared to the passive knee extension test the active knee extension test shows the functional limitation of the individual.

In a study done by Michael V Winters et al, they compared passive stretching versus active stretching of hip flexor muscles in patients with limited hip extension, with a sample size of 33 subjects. Form baseline to 3 weeks 12 degrees of improvement was observed in active stretching group and 13 degrees of improvement was observed in passive stretching group .They concluded that both active stretching and passive stretching were effective in improving the extensibility. There was no statistical significance between the groups. In present study as well as the study done by Michael V Winters et al modified Thomas test was used to assess hip flexor tightness [27]. The outcome of the present study is in accordance with Michael. V Winters et al both active and passive stretching showed statistical significant change when compared to the baseline. Also both studies did not show a significant change in between groups. In the present study the treatment parameter was fixed for active stretching at 10 sec hold and was repeated for 10 times to keep it uniform for all subjects.

In a study done by Kieran O'Sullivan et al, they analyzed the effect of warm up, static stretch and dynamic stretch on the hamstring muscle in previously injures subjects, with sample size of 36 subjects. They concluded that warm up improved flexibility as well as static stretching

improved hamstring flexibility whereas dynamic stretching did not improve hamstring flexibility. In the present study active stretching was compared with passive stretching for the hip and knee flexors. In the study done by Kieran O'Sullivan et al static stretching and dynamic stretching was compared on the flexibility of hamstring [43]. In the present study both the groups, limb was maintained in a stretched position where as in the dynamic stretching group the individual took the limb into flexion till a stretch was felt and this was repeated for 30 seconds and repeated 3 times. In the present study there was a significant increase in flexibility among both the individuals who underwent active as well as passive stretching program.

In a study done by D Scott Davis et al they compared the effectiveness of static stretching, active self stretching and proprioceptive neuromuscular facilitation (PNF) on hamstring flexibility using consistent parameters, with sample size of 19 individuals. Passive knee extension test in 90-90 degree position was used to measure hamstring flexibility. The results suggest that there was no statistical difference in any of the groups compared to the control group at 2 weeks of intervention, there was statistically significant difference in all the three stretches on the hamstring flexibility compared to their own baseline values at 4 weeks of intervention. Only the static stretching produced a statistically significant difference when compared to the control group. However there was no significant difference found between the static stretch compared with the other two stretches. They concluded that static stretching of hamstring is more beneficial than self stretch and PNF stretching in improving the hamstring flexibility, while using a 30 second stretch applied 3 days per week for 4 weeks [39]. It has been recommended to use one 30 second stretch applied 3 days per week for 4 weeks for individuals who have tight hamstring (Scott Davis). In the present study active knee extension test was used to measure hamstring flexibility. Whereas the study done by D Scott Davis used passive knee extension test. According to Richard L Gajdosik et al active knee extension measures initial hamstring length where as passive knee extension test measures the maximal length [42]. This could have had an impact on both the studies.

The results of the present study prove that both active and passive stretching is beneficial in improving the flexibility of tight muscles in the lower limbs. Also both active stretching and passive stretching has a profound effect on the functional aspect in patients suffering with low back pain. The benefits of active stretching are that the individual could perform the stretch without any assistance, less supervision was needed and the individuals knew their limits of flexibility and were able to work on improving their flexibility keeping in mind their levels of tightness as well as having the goal to reach a complete knee extension from the 90-90 degree position.

There have been few limitations for the study such as small sample size, lack of control group without intervention, short treatment duration, varying parameters of treatment between the groups. For research purpose homogenous setting of parameters would help to eliminate bias in between the groups, and a better comparison could be achieved. The present study has not analyzed the effect of type of stretch on the function of the antagonist muscle (hip extensors and the quadriceps).

CONCLUSION

The result of present study conveys that both active and passive stretch is helpful in improving the flexibility in the major muscle groups of lower extremity. Scope for further studies is open with a larger sample size, homogenous parameters of treatment.

Conflicts of interest: None

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