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A Comparative study on the effect of Dynamic oscillatory stretch and core-activated hamstring stretch to improve Hamstring and Lumbar extensibility in young adult

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ABSTRACT

The hamstring muscle is important for flexibility in the human body and is susceptible to tightness which leads to difficulty in extending the knee completely when the hip is flexed. Study aims to discover the efficacy of two distinct flexibility training to improve hamstring and lumbar extensibility. To compare the effect of dynamic oscillatory stretching and core-activated hamstring stretch on hamstring and lumbar extensibility in young adults. It is a Quasi-experimental study with 246 participants dispensed into two different groups. In group 1 (DOS) and Group 2 (Core activated hamstring stretch), AKE was used for measuring hamstring flexibility and ROM using a baseline bubble inclinometer. The gender proportion between the groups was significant the subjects were ranging within 20-21 years the SD and mean of 20.821±0.384 in Group-A. In Group-B, with SD and mean of 20.821±0.384. The age distribution between the two groups was not significant (F=0.741, p>0.05). Between the group's Parametric ANOVA (F-test), Pretest AKE (degree) (F-test=0.071, p>0.05), Baseline bubble Inclinometer (degree) (F-test=3.87, p>0.05). Post-test AKE (degree) (F-test=37.40, p<0.001), Baseline bubble Inclinometer (degree) (F-test=24.18 p<0.001). The DOS group were better than core activated stretch in improving flexibility and ROM.

Keywords: *DOS (Dynamic oscillatory stretch), Core activated hamstring stretch, AKE (Active knee extension angle), Inclinometer, Hamstring and Lumbar extensibility.*

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INTRODUCTION

Muscular flexibility is defined as the available ROM in a joint that will be impacted by tendons, bones, ligaments and muscles [1]. Flexibility dysfunction leads to the most common widespread problems and it affects a range of motion leading to other musculoskeletal complications that influence normal functioning [2, 3]. A sedentary lifestyle is a primary cause of abnormalities in posture. The educational setups and professions requiring long hours of sitting can affect flexibility and range of motion [4]. Nischal Ratna Shakya et.al mentioned in their findings that, tightness of the hamstring seems to progress greatly after 30 years and the importance of flexibility and in one of the studies 77.9% of the young adults experienced pain in the lower back [5]. Sheetal Mahadik in the study of hamstring tightness prevalence in young adults concluded that 82% had tightness while measured using the AKE test [6]. James Harty et.al in their article mentioned that hamstring tightness can be a reason for plantar fasciitis [7]. Hamstring tightness showed a direct correlation with low back pain in severe cases [8]. Decreased flexibility of hamstrings also leads to decreased ROM and leads to increased postural problems and compression of the blood vessels leading to decreased optimal performance [4, 9]. Kendall and McCreary (Muscles testing and function,1984) argued that people with a decreased lumbar curve in standing position have shortened hamstrings.

In general population pain in the lower back is experienced by 80 per cent of the population in which tightness of the hamstring plays a strong correlation [10, 11, 12]. Esola MA et.al in a study stated that spino-pelvic rhythm alteration can contribute to pain in the lower back and leads to disturbance in movement [13]. Recently Hasebe et al in healthy subjects found increased pelvic motion with flexible hamstrings than with tight hamstrings [14]. The conventional type of stretching hamstring is static; it increases hamstring flexibility over an extended treatment duration. Static stretch was effective in the prevention of injuries caused due to decreased flexibility and in treating sports injuries. They found that a stretch for 15secs is effective as a 30, 60, 90, or 120-second stretch while it is done for 6 weeks continuously. DOS is a (PNF) technique which is modified. In DOS the agonist muscle group produces a

stretching force on the antagonist muscle which is similar to agonist contract-relax [15]. It incorporates a modification of oscillatory manual stretch for two-second at the end range, applied by the therapist for assisting the agonist. Core-activated hamstring stretching is a combination of core activation with active stretching, which results in improving toe touch performance by theoretically facilitating proper core activation patterns during movement or helping in decreasing neural tone. Stretching with maintaining a stable and facilitated core may lead to improved stretch depth per a more optimal movement pattern [16].

The need for study arises as evidence supporting these differences is inconclusive in the younger population, according to Beaulieu et al. one who leads a sedentary lifestyle is more susceptible to diminished flexibility. The aim of conducting this study was that the majority of research is based on flexibility targeting mostly the population of the elderly and the majority of clinical studies concerning ROM between men and women target the elderly people. Ghulam Fatima et.al, also stated that hamstring tightness is found to be more in students or young adults and there is a correlation found between extended sitting hours and a sedentary lifestyle. Arie Michaeli *et al*, [15] suggested that DOS shows more effectiveness than the static type of stretch as there was an increased stretch tolerance for DOS. The DOS technique is an effective stretching technique with greater tolerance to the technique [15]. David Edwards [16] proved both traditional and core-activated hamstring stretches to produce a remarkable difference in hamstring extensibility. The need for study is to create awareness among young individuals about the effects of a lack of normal flexibility and the importance of stretching daily, to prevent conditions such as pain in the lower back and postural problems [16]. Both traditional types of stretching and core-activated hamstring stretching produced significant increases in both toe touch and AKE hamstring extensibility, neither of the technique showed statistically more effectiveness than the other. The study has shown evidence that static stretching is an effective resource for increasing tissue extensibility acutely [16]. But the study aims to find the effectiveness of dynamic oscillatory stretching versus core-activated hamstring stretch for improving flexibility of hamstring and lumbar extensibility in young adults, to provide education and to raise awareness among these groups of individuals to encourage and supervise to seek early medical intervention and treatment of musculoskeletal disorders before they become chronic.

MATERIALS AND METHODS

The design of the study used is a pre and post-comparative study with a sample size of 246 subjects assigned into 2 groups using Slovin's formula.

The study setting and source of data was from Krupanidhi college of Physiotherapy, (Outpatient department) with a study duration of 1 year. The samples collected were young adults in the age group of 20-25 years of age and sampling was done by simple randomized sampling.

Selection criteria are based on inclusion and exclusion. Individuals with an AKE angle greater than 20° and individuals with an inclinometer score less than 52.30° of lumbar flexion and both genders were selected. Excluded subjects with low back pain past 1 year, individuals involved in regular hamstring muscle stretch or any direct injury to the hamstrings, any surgery of hamstrings or lumbar muscles and lower extremity fracture or spine fracture in the past 6 months.

A total of 246 participants will be selected based on inclusion and exclusion criteria. They will be provided with instructions and needs of the study, the procedures, the risks and the benefits. Consent will be signed by the interested participants. The general condition of the participant will be assessed before being subjected to the treatment.

Group 1 (Experimental) – Dynamic oscillatory stretch + Conventional stretch Group 2 (Experimental)– Core activated hamstring stretch + Conventional stretch

Procedure

Dynamic Oscillatory Stretch:

Starting position: The participants were in a supine position with the knee in extension and the foot in dorsiflexion. A lumbar roll will be used to maintain the participant's lumbopelvic lordosis in a neutral position. Then the leg will be raised passively till we get the stretch sensation participants will be asked to assist the stretch by contracting the hip flexor muscles, (psoas major, iliacus and rectus femoris) while the knee extended.

A low passive stretch at the end range will be applied and contraction of the agonist muscle group will be continued with the stretch. The procedure will be carried out 10 times in 3 sets. The time taken will be 60 secs, 10 repetitions in 3 sets holding for 2 minutes [15].

Core-Activated Hamstring Stretch:

Starting position: The subjects were instructed to keep their feet together and stand and to make a triangle with their thumb and forefinger of each hand and place their hands on an exercise ball placed in front of them.

The subject will be then asked to brace their abdominals and press into the exercise ball with their upper extremities and bring their nose towards the exercise ball to perform the stretch. Subjects will be asked to bend their elbows as they brought their nose to their hands. This exercise will be performed for 3 sets of 10 repetitions with a 2-second hold at the bottom of the stretch.[16]

Conventional Stretch

Subjects were in the supine position and were instructed to put an exercise stretch band under the plantar surface of the foot and to maintain knee extension at 0 degrees while flexing their hip to the farthest tolerable position to apply a static stretch.

Exercise will be performed holding the position for 30 seconds, for 3 repetitions on each limb. [16]

Measurement Tool and Method

Using a goniometer AKE angle for hamstring flexibility will be measured, knee flexed at 90° and foot in a neutral position, using a goniometer by placing it on the lateral femoral condyle. The subject will be instructed to do knee extension with a strong resistance keeping it for 2 to 3 secs. Reading will be taken and rest for 1 min will be given and a second trial will be carried out. [19] A bubble inclinometer was used to measure lumbar ROM. The reference points are S_1 and T_{12} while measuring the ROM. The range is calculated by subtracting the number got from the lower inclinometer from the number got from the upper inclinometer [20].

Outcome measures

Active knee extension angle [19]

Baseline bubble inclinometer [20]

Post-Intervention Measurement:

The patient will undergo again in evaluation with hamstring and lumbar extensibility using a Goniometer and Baseline bubble inclinometer.

The patient will be given icing for 10 to 15 mins to relieve stretch-induced pain

Statistical analysis

It was carried out with independent t-tests and paired t-tests between the groups and within groups respectively. The data were analyzed using SPSS software

RESULTS

Of the young adults, the proportion 78(63.41%) of them were males and 45(36.58%) of them were females in Group-A. In Group-B, 74(60.16%) of them were males and 49(39.83%) of them were females. The gender ratio between both groups was not significant the subjects were ranging between 20-21 years and the mean –SD of 20.821 ± 0.384 within Group-A. And in Group-B, the subject's range was within 20-21 years with a mean SD of 20.821 ± 0.384. The age distribution between the two groups was not significant (F=0.741, p>0.05). It evidenced that the subjects were homogeneous in all the groups when compared with pre and post-test outcome measures among young adults in between the groups. For Group-A, the pre-test AKE Mean ±SD (36.37±4.13), Baseline bubble Inclinometer (degree) Mean ±SD (42.37±6.85). And post-test AKE Mean ±SD (30.24 ± 4.31), Baseline bubble Inclinometer (degree) Mean ±SD (47.63±6.79). For Group-B, pre-test AKE Mean ± SD (36.5±4.009) Baseline bubble Inclinometer (degree) Mean ± SD (40.59 ± 7.352) and post-test AKE Mean ±SD (33.55± 4.167), Baseline bubble Inclinometer (degree) Mean ±SD (43.23± 7.254). Between groups comparisons/ Parametric ANOVA (F-test), Pretest AKE (F-test=0.071, p>0.05), Baseline bubble Inclinometer (degree) (F-test=3.87, p<0.001). Post-test AKE (F-test=37.40, p<0.001), Baseline bubble Inclinometer (degree) (F-test=24.18 p<0.001).The interventions in each group were individually effective in improving outcome measures of young adults. But, the interventions in Group-A were better than the interventions in Group-B in improving outcome measures of young adults

Table 1: Distribution of young adults according to gender in both groups and mean and SD of the age of the young adults in between the groups.

S.no	Gender	Group-A	Group-B	Chi-square value	Group-A	Group-B	F-TEST	P-VALUE
		No. (%)	No. (%)		RANGE			
					20-21	20-21		
1	Male	78 (63.41%)	49 (39.83%)	0.7415 p =0.5 p >0.05	MEAN		F=0.741	P=0.968 p>0.05
2	Female	45 (36.58%)	74(60.16%)		20.821±0.384	20.821±0.384		

The table shows the proportion of young adults according to gender and the mean and SD of the age of young adults in between the groups.

The gender proportion between the groups was not significant (Chi-square value=0.7415 p>0.05). The subjects were ranging between the age of 20-21 with a mean and SD of (20.821±0.384) in both groups. The age distribution of the two independent groups showed to be not significant (F=0.74, p>0.05). It shows that the subjects were homogeneous in all the groups.

Table2: Mean and SD of outcome measures of young adults in Group-A.

SL.NO	GROUPS	GROUP A		Paired t-test	P-value
		PRE	POST		
		Mean ± SD	Mean ± SD		
1	**AKE (degree)**	36.37±4.13	30.24 ± 4.31	t =31.379	P=0.000
					p<0.001
2	**Bubble inclinometer (degree)**	42.37±6.85	47.63± 6.79	t =31.41	P=0.000 p<0.001

The above table-2 shows the pre and post-test outcomes among young adults in Group-A in the pre-test, the AKE (degree) with mean and SD of 36.37±4.13. In post-test, it was found with a mean and SD of 30.24 ± 4.31. The parametric test for comparison of dependent outcomes, and the paired t-test test were carried out and it was found to be significant (p<0.001).

In the pre-test, the Bubble inclinometer (degree) with mean and SD of 42.37±6.85 and in the post-test, it was found with a mean and SD of 47.63±6.79. The parametric test for comparison of dependent outcomes, and the paired t-test test were carried out and it was found to be significant (p<0.001).

It evidences that there is a significant increase in outcome measures among young adults in Group-A.

Table 3: Mean and SD of outcome measures of young adults in Group-B.

SL. NO	GROUPS	GROUP B			P-value
		PRE	POST		
		Mean±SD	Mean±SD	Paired t- test	
1	**AKE (degree)**	36.5±4.009	33.55± 4.167	t = 38.17	P=0.000p<0.001
2	**Bubble nclinometer (degree)**	40.59±7.352	43.23± 7.254	t=-46.31	P=0.000p<0.001

In the pre-test, the AKE (degree) with mean and SD of 36.5±4.009. But in the post-test, it was found to be with mean and SD of 33.55± 4.167. The parametric test for comparison of dependent outcomes, and the paired t-test test were carried out and it was found to be significant (p<0.001).

In the pre-test, the Bubble inclinometer (degree) was with mean and SD of 40.59 ± 7.352 But in the post-test, it was found to be with a mean and SD of 43.23±7.254. The parametric test for comparison of dependent outcomes, and the paired t-test test were carried out and it was found to be significant (p<0.001). It evidences that there is a significant increase in outcome measures among young adults in Group-B.

Table 4: Comparison of pre and post-test outcome measures among young adults within the groups.

SL.NO	GROUPS	GROUP-A (PRE-POSTTEST)	Within the group comparisons t-test
		Mean ±SD	
1	**AKE(degree)**	6.122 ± 2.16	t = 31.379 p =0.000
2	**BI(degree)**	-5.268±1.86	t=-31.41 p=0.000

In Group A the pre and post-test mean and SD of AKE (degree) are 6.122 ± 2.16. And the pre and post-test mean and SD of BI (degree) are -5.268 ±1.86. The parametric test for comparison of dependent outcomes, and the paired t-test test were carried out and it was found to be significant (p<0.005)

Table 5: Comparison of pre and post-test outcome measures among young adults within the groups.

SL.NO	GROUPS	GROUP-B (PRE-POSTTEST)	Within the group comparisons (t-test)
		Mean ±SD	
1	**AKE (degree)**	2.951± 0.857	t =38.17 p =0.000
2	**BI (degree)**	-2.634± 0.631	t=-46.31 p =0.000

In Group B pretest and posttest of AKE (degree) is 2.951± 0.857. And the pretest and post-test of BI (degree) are -2.634 ± 0.631. The parametric test for comparison of dependent outcomes, and the paired t-test test were carried out and it was found to be significant (p<0.005).

Table 6: Comparison of pre and post-test outcome measures among young adults in between the groups.

Sl.No.	Groups	Pre-test		Posttest	
		AKE (degree)	Bubble Inclinometer (degree)	AKE (degree)	Bubble Inclinometer (degree)
		Mean±SD	Mean±SD	Mean±SD	Mean±SD
1	Group-A	36.37±4.13	42.37±6.85	30.24 ± 4.31	47.63± 6.79
2	Group-B	36.5±4.009	40.59±7.352	33.55± 4.167	43.23± 7.254
Between groups comparisons/Parametric ANOVA(F-test)		F-test=0.071 p=0.79 p>0.05	F-test=3.87 p=0.000 p<0.001	F-test=37.40 p=0.052p<0.001	F-test=24.18 P=0.000p<0.001

DISCUSSION

Both core-activated hamstring stretches and conventional techniques showed positive effects on hamstring flexibility and lumbar extensibility. But only a few reports on the effect of (DOS) combination of Static stretch, Oscillatory mobilization and Proprioceptive neuromuscular facilitation on the extensibility of the hamstring. The results of this study show that both core-activated hamstring stretch and DOS protocols improve hamstring extensibility and lumbar ROM. The age distribution between the groups was not significant (F=0.7415 p>0.05). Between the group's Parametric ANOVA (F-test), Pre-test AKE (degree) (F-test=0.071, NS, p>0.05), Baseline bubble Inclinometer (degree) (F-test=3.87, NS, p<0.001). Post-test AKE (degree) (F-test=37.40, S, p<0.001), Baseline bubble Inclinometer (degree) (F-test=24.18, S, p<0.001).

Arie Michaeli et.al, compared between DOS, Static and control groups and found in their study that the dynamic group found a positive increase than the static group (Control 73 ± 12°, SS 86 ± 8°, DOS 94 ± 11°, p< 0.001). Post-intervention, hamstring flexibility in the DOS group was found greater (Control 73 ± 12°, SS 80 ± 8°, DOS 89 ± 12°, p=0.001). The outcome measure to check hamstring flexibility was the SLR test and pain using VAS (Visual Analog Scale) [15].

David Edwards et.al, in their study, found that both groups showed improved flexibility from pre-test to post-test and the conventional group showed a positive increase in the toe-touch test and sit and reach test and 0.000 p-values. The 2nd group also showed positive results with a 0.000 p-value. It didn't show a greater difference between the groups (p=0.471andp=0.826) Outcome measures used were the Toe-touch test and Sit and reach test (SRT) [16].

Hamstring muscles are prone to tightness leading to musculoskeletal problems. Worrell *et. al*, 1994 mentioned in their study that improving the flexibility of the hamstring group of muscles was found effective to improve muscle performance of the hamstring group.[25] Muscular tightness is one of the main causes of a restricted or limited range of motion, it leads to decreased flexibility of joints and pain in the lower back. The results demonstrate that in all the 2 groups A and B i.e., dynamic oscillatory stretching and Core-activated hamstring stretch showed improvement in hamstring extensibility. Core-activated hamstring stretch also proved to be effective in improving the extensibility of the muscle but not significantly greater than DOS or conventional stretch. Young adults with faulty core activation patterns benefitted most, stretching with a stable and facilitated core can improve stretch depth but increased benefits may be reached by a prolonged treatment schedule. [16]

DOS group was greater in showing improvement than the other group, not only the flexibility improved but also the pain response appeared to be less immediately post stretch when compared to another group.

The stretch tolerance of the muscle and extensibility in the DOS supports the theories of reflex muscle relaxation and muscle property changes. Nee and Butler in their study found that oscillatory type of movements leads to improvement in symptoms and shows improvement in intraneural circulation, axoplasmic flow, and neural connective tissue viscoelasticity. The differing mechano-sensitivity of the neural system in the posterior thigh is a plausible mechanism for improving the flexibility of the hamstring using dynamic oscillatory stretch. [15].

DOS can modify stretch tolerance but it requires RCT on individuals with symptoms and wide age groups, follow-ups, using effective techniques for changing tolerance to stretch. This study is based on healthy and younger adults [15]. DOS can provide good stretch tolerance to the technique. The results prove that DOS is better compared to stretch tolerance than the other 2groups and effective in improving the

flexibility of the hamstring [15].

LIMITATIONS AND SUGGESTIONS

This study was done for 4 weeks. A longer-duration study would provide better results. And all subjects were healthy and pain-free. Larger sample size with a prolongation of follow-up time is recommended to make the study more reliable. Reached by prolonged treatment schedule. More studies need to be done on DOS to understand the effectiveness.

CONCLUSION

The interventions in each group were individually effective in improving outcome measures of young adults. But, the interventions in Group-A were better than the interventions in Group-B in improving outcome measures of young adults.

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