RESEARCH ARTICLE

Comparison of treatment outcome of proprioceptive neuromuscular facilitation (hold-relax) technique and muscle energy techniques on hamstring tightness in asymptomatic males

Abstract

Objective: The purpose of this study was to see the comparison of the effectiveness of PNF (hold-relax) stretching and Muscle energy technique on hamstring tightness in asymptomatic males.

Methodology: This randomized clinical trial was conducted at the OPD physiotherapy department, PSRD Lahore. In this study 60 males were randomly selected in three groups GROUP A males were treated with PNF hold relax stretching. GROUP B males were treated with METS (post isometric relaxation) GROUP C males were treated with METS (autogenic inhibition)

Performa was filled and informed consent was taken from each male. Questioner used for data collection was AKET, SLR, Sit and Reach test were also used for assessment of hamstring tightness.

GROUP A: PNF (hold relax) stretching 30 sec 3 times=1 session 4 sessions in two weeks.

GROUP B: METS (post isometric relaxation) 10 sec 3 times=1 session 4 sessions in 2 weeks.

GROUP C: METS (autogenic inhibition) 10 sec 3 times=1 session 4 sessions in 2 weeks.

Results: Males in group A showed marked improvement as compared to group B and C. P value (0.000) less than 0.05 is considered significant. The mean age of Males for Group A and B was 26+1.2 and 26+0.9 respectively and for group C Mean value was 27+1.16.

Conclusion: It is concluded from the study that PNF hold relaxed stretching of hamstrings in males with hamstring tightness is a significant treatment outcome on AKET more than METS. However, on SLR and SART, all three techniques have an equal effect. When groups B and C were analyzed it was seen that Group B and C showed significant results on AKET, SLR test, sit and reach test and have effect in improving the outcome but the two groups have an insignificant difference between each other so they both have an equal effect, both are equally effective.a.

Keywords: PNF (Proprioceptive Neuromuscular Facilitation), METs (Muscle Energy Techniques), Muscle Tightness

Introduction

A decrease in muscular flexibility reduces not only the functional level of an individual but also harms the musculoskeletal system due to overuse [1]. The capability of an individual to move efficiently depends on his flexibility. It is a fundamental element that allows the tissue to adapt easily to stress. Muscle tightness is caused by a decrease in the ability of a muscle to deform which results in decreased range of motion at the acting joints [2]. Hamstrings are a group of muscles that tend to get shortened. These are the three muscles that cover the posterior aspect of the thigh, consisting of the biceps femoris, semitendinosus, and semimembranosus [2]. Tightness of this muscle group results in the prevalence of low back pain [3]. Hamstrings are two joint-acting muscles and are most frequently damaged in the body [4]. The hamstring belongs to the muscles of the posterior compartment of the thigh. Among

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semimembranosus, semitendinosus, and biceps femoris, the short head of the biceps does not cross the knee joint. Mobility is associated with the integrity of the joint as well as flexibility or ward extensibility. This is essential for pain-free and smooth unrestricted movements of the body to perform daily activities of life [5]. Hypomotility is Reduced mobility and limited motion are terms used to describe hypomobility. There is a wide range of pathological processes which limit movement and impair mobility. Hypo mobility due to adaptive shortening of soft tissues is a result of different disorders or malfunctioning [6]. Dynamic flexibility is also called active mobility or active range of motion of a joint. An extent to which muscle contracts actively to move a segment of the body in an available range of motion. It depends on the extent of joint mobility and tissue resistance faced during movement [6]. Passive mobility or passive range of motion. An extent to which a segment of the body is passively moved in an available range. It is dependent on the flexibility of surrounding muscles and connective tissues of a joint [6]. Dynamic stretching, an external force is applied to move the body segment beyond the point of resistance and within the available room. The site of stabilization, the direction of speed, duration, and intensity of stretch is controlled by the therapist. It can also be achieved passively by the patient with assistance or independently [6]. Static stretching, a widely used method to increase the length of muscle by autogenic inhibition which excites the Golgi tendon organ. In this procedure, the resistance to musculotendinous stretching not only involves the viscoelastic properties of connective tissues and muscles but also involves neurological reflex [1]. Muscle energy technique is a manual technique developed by osteopaths that are used by many Professionals. It is effective because of many reasons because it helps in lengthening a Shortened muscle, strengthening a muscle, as a lymphatic or pump to assist the drainage of fluid and blood, and helping in increasing the range of motion of a limiting joint [7].

Objective

■ Primary objective

The Aims and objective of the study are to find out the more effective treatment technique for hamstring tightness.

■ Secondary objective

To find out the effect of hamstring stretching on the improvement of chronic back pain.

To increase the hip range of motion of flexion.

To increase the knee extension range of motion.

Hypothesis

■ Null hypothesis

There is no difference between proprioceptive neuromuscular facilitation stretching and muscle energy technique (autogenic inhibition) in the improvement of hamstring tightness.

■ Alternative Hypothesis

Muscle energy technique (autogenic inhibition) is more effective. The proprioceptive neuromuscular facilitation(hold-relax) in increasing the hamstring muscle. Tightness is more effective. Muscle energy technique (reciprocal Inhibition) is more effective. All three interventions have the same effect on improving hamstrings extensibility.

Material and methods

It is a Quasi Randomized Clinical Trial (Q-RCT). The study is to be done at the OPD Department of PSRD (Pakistan Society of Rehabilitation and Disability) Study was completed within 6-8 months.

Nonprobability purposive sampling technique is to be used. Group allocation was goldfish randomization.

Group A patient was treated with proprioceptive neuromuscular facilitation (hold-relax).

Group B patient was treated with muscle energy technique (post isometric relaxation).

Group C patient was treated with muscle energy technique (autogenic inhibition).

■ Sample size calculation

A prior analysis for repeated measure ANOVA within and between interactions was run using:

F=0.25

Alpha=0.05

Beta=0.95

Was run to calculate sample size which gave us a sample size of 54 considering the margin of dropout a sample size of 60 clients will be taken by dividing 20 participants in each group.

Software is G POWER 3.0.10

■ Data analysis

Data entry and analysis are to be done by using SPSS 16. Quantitative variables are to be presented by using mean SD. Qualitative variables are to be presented by using frequency tables and appropriate graphs where applicable. ANOVA is to be applied to see the difference in the treatment outcome on SLR, sit and reach test, Active knee extension test.

■ Inclusion criteria

Age 20-30 years.

Females

90-90 test<50

SLR<70

■ Exclusion criteria

Neurological problem with lumber region.

Patient with back and spine fractures.

Patient with any structural deformity of the spine.

Patients with Mental disabilities

Patient with an active complaint of low back pain and lower extremity.

Females.

Methods

A total of 60 asymptomatic male subjects of PSRD College of Rehabilitation Sciences with hamstring muscle tightness were included in the study. The criteria for inclusion were healthy males between the ages of 20 and 30 years with hamstring muscle tightness of 20 degrees (inability to achieve greater than 160° of knee extension with hip at 90° of flexion is considered hamstring tightness). Subjects were excluded if they had a neurological problem in the lumbar region, any Deformity of the knee, hip, and back, history of participation in a stretching or yoga program in the last six months, history of trauma at the hip, knee, or back, or any injury to the hamstring and other muscles in the lower limb. The study received ethical clearance, and informed consent was received before the intervention from each subject. The subjects were screened according to the inclusion criteria. They were randomly allocated through the goldfish method of randomization into three groups. Measurements of the dependent variable were obtained by another therapist who was blinded to group assignment. Informed consent will be taken from every male telling about the safety of the study and their right to withdraw from the study at any time. Demographic details (name, age, sex) will be noted along with medical history.

Group A receives moist superficial heat and the PNF (Hold-Relax) technique of stretching.

Group B receives moist superficial heat and METS (reciprocal inhibition technique).

Group C receives moist superficial heat METS (autogenic inhibition technique).

For PNF Hold-Relax Technique each subject in Group A was comfortably positioned in a supine lying position on a plinth with the hip fixed at 90 degrees of flexion, and a therapist then stretched the hamstrings passively until the subject felt and reported a mild stretch sensation; that position was held for 30 seconds. The subjects were asked to perform maximal isometric contractions of the hamstrings for 7 seconds by attempting to push their leg back toward the table against the resistance of the therapist. After the contraction, the subjects were instructed to relax for 5 seconds. This sequence was repeated three times for each session equal to one set on the alternate days.

Group-B males were treated with METS (reciprocal inhibition technique) 10 seconds thrice equal to one set and three sets on alternate days in a week were given.

Group-C males were treated with METS (autogenic inhibition) 10 seconds hold thrice equal to one set and three sets on alternate days in a week were given.

■ Assessment criteria

Data was collected by the assessor by using a pre-designed Performa. Improvement regarding the outcomes of the treatment was measured by using SLR, Sit and Reach test, and Active Knee Extension Test.

Results

■ Mean values of age and BMI (TABLE 1 and TABLE 2)

TABLE 1. Mean values of age and BMI

Descriptive Statistics						
Treatment group of patient		**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Group 1	age of participant	20	23	28	25.5	1.67
	height of participant	20	53	65	61.447	2.9283
	weight of participant	20	30	70	49.51	10.989
	straight leg raising pre-value	20	65	90	74.65	6.513
	BMI	20	11.95	33.08	20.4779	5.09808
	sit and reach test Pre-treatment	20	7.62	30.8	19.1978	7.50212
	aketpre1	20	113.64	130	123.058	5.69371
	Valid N (listwise)	20				
Group 2	age of participant	20	24	28	25.9	1.41
	height of participant	20	53	67	61.005	3.5174
	weight of participant	20	40	83	57.86	14.125
	straight leg raising pre-value	20	59	90	77.9	8.053
	BMI	20	14.62	42.95	24.1877	6.20355
	sit and reach test Pre-treatment	20	6.35	23.47	15.6315	4.17474
	aketpre1	20	117	133.45	125.442	5.50883
	Valid N (listwise)	20				
Group 3	age of participant	20	25	30	27.8	1.704
	height of participant	20	57	65	61.769	2.17
	weight of participant	20	43	70	55.56	7.673
	straight leg raising pre-value	20	73	97	82.77	7.619
	BMI	20	18.35	29.28	22.5874	3.00405
	sit and reach test Pre-treatment	20	6.54	27.94	16.9144	5.21447
	aketpre1	20	118.3	136.01	128.186	5.37373
	Valid N (listwise)	20				

TABLE 2. Within subjects effects SLR.

Descriptive Statistics				
Treatment group of patient		**Mean**	**Std. Deviation**	**N**
Group 1	straight leg raising pre value	74.65	6.513	20
	straight leg raising first session value	73.39	4.466	20
	straight leg raising second session value	78.92	4.463	20
	straight leg raising third session value	83.32	3.616	20
	straight leg raising fourth session value	89.36	2.42	20
Group 2	straight leg raising pre value	77.9	8.053	20
	straight leg raising first session value	81.36	9.926	20
	straight leg raising second session value	87.21	8.538	20
	straight leg raising third session value	88.9	8.746	20
	straight leg raising fourth session value	89.9	9.474	20

Group 3	straight leg raising pre value	82.77	7.619	20
	straight leg raising first session value	88.42	9.793	20
	straight leg raising second session value	91.2	12.906	20
	straight leg raising third session value	94.35	9.692	20
	straight leg raising fourth session value	93.51	9.615	20

■ SLR within subject's effects (TABLES 3-12)

TABLE 3. Tests of Within-Subjects Effects (Straight Leg Raise).

Straight Leg Raise							
Treatment group of patient	**Source**		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Group 1	factor1	Sphericity Assumed	3440.682	4	860.171	54.05	0
		Greenhouse-Geisser	3440.682	2.034	1691.269	54.05	0
		Huynh-Feldt	3440.682	2.28	1508.838	54.05	0
		Lower-bound	3440.682	1	3440.682	54.05	0
	Error (factor1)	Sphericity Assumed	1209.498	76	15.914		
		Greenhouse-Geisser	1209.498	38.653	31.291		
		Huynh-Feldt	1209.498	43.327	27.916		
		Lower-bound	1209.498	19	63.658		
Group 2	factor1	Sphericity Assumed	2154.607	4	538.652	11.739	0
		Greenhouse-Geisser	2154.607	3.115	691.72	11.739	0
		Huynh-Feldt	2154.607	3.796	567.627	11.739	0
		Lower-bound	2154.607	1	2154.607	11.739	0.003
	Error (factor1)	Sphericity Assumed	3487.433	76	45.887		
		Greenhouse-Geisser	3487.433	59.182	58.927		
		Huynh-Feldt	3487.433	72.12	48.356		
		Lower-bound	3487.433	19	183.549		
Group 3	factor1	Sphericity Assumed	1750.52	4	437.63	8.076	0
		Greenhouse-Geisser	1750.52	2.707	646.669	8.076	0
		Huynh-Feldt	1750.52	3.2	547.017	8.076	0
		Lower-bound	1750.52	1	1750.52	8.076	0.01
	Error (factor1)	Sphericity Assumed	4118.201	76	54.187		
		Greenhouse-Geisser	4118.201	51.433	80.07		
		Huynh-Feldt	4118.201	60.802	67.731		
		Lower-bound	4118.201	19	216.747		

TABLE 4. Estimated marginal means (Straight Leg Raise).

Straight Leg Raise					
Treatment group of patient	**factor1**	**Mean**	**Std. Error**	**95% Confidence Interval**	
				Lower Bound	**Upper Bound**
Group 1	1	74.654	1.456	71.606	77.702
	2	73.394	0.999	71.304	75.485
	3	78.919	0.998	76.83	81.008
	4	83.316	0.809	81.623	85.008
	5	89.364	0.541	88.231	90.496

Group 2	1	77.902	1.801	74.133	81.671
	2	81.358	2.22	76.712	86.004
	3	87.212	1.909	83.216	91.208
	4	88.901	1.956	84.808	92.995
	5	89.898	2.118	85.464	94.332
Group 3	1	82.765	1.704	79.2	86.331
	2	88.419	2.19	83.835	93.002
	3	91.203	2.886	85.162	97.243
	4	94.351	2.167	89.815	98.887
	5	93.509	2.15	89.009	98.009

TABLE 5. Within subjects effects SART.

Descriptive Statistics

Treatment group of patient		Mean	Std. Deviation	N
Group 1	sit and reach test Pre treatment	19.1978	7.50212	20
	sit and reach test after 1st session	17.7236	7.71662	20
	sit and reach test after 2nd session	16.9312	8.08717	20
	sit and reach test after 3rd session	19.8133	7.19791	20
	sit and reach test after 4th session	24.6253	5.90005	20
Group 2	sit and reach test Pre treatment	15.6315	4.17474	20
	sit and reach test after 1st session	17.5396	5.35018	20
	sit and reach test after 2nd session	21.2855	5.87083	20
	sit and reach test after 3rd session	21.2877	4.67437	20
	sit and reach test after 4th session	23.8136	5.75489	20
Group 3	sit and reach test Pre treatment	16.9144	5.21447	20
	sit and reach test after 1st session	18.474	3.39046	20
	sit and reach test after 2nd session	20.9177	4.37805	20
	sit and reach test after 3rd session	21.9964	3.68976	20
	sit and reach test after 4th session	22.9301	3.24912	20

TABLE 6. Multivariate Tests.

Multivariate Tests[a]

Treatment group of patient	Effect		Value	F	Hypothesis df	Error df	Sig.
Group 1	factor1	Pillai's Trace	0.904	37.771[b]	4	16	0
		Wilks' Lambda	0.096	37.771[b]	4	16	0
		Hotelling's Trace	9.443	37.771[b]	4	16	0
		Roy's Largest Root	9.443	37.771[b]	4	16	0
Group 2	factor1	Pillai's Trace	0.82	18.177[b]	4	16	0
		Wilks' Lambda	0.18	18.177[b]	4	16	0
		Hotelling's Trace	4.544	18.177[b]	4	16	0
		Roy's Largest Root	4.544	18.177[b]	4	16	0

Group 3	factor1	Pillai's Trace	0.821	18.350[b]	4	16	0
		Wilks' Lambda	0.179	18.350[b]	4	16	0
		Hotelling's Trace	4.588	18.350[b]	4	16	0
		Roy's Largest Root	4.588	18.350[b]	4	16	0

a. Design: Intercept, Within Subjects Design: factor1, b. Exact statistic

TABLE 7. Sitandreach test.

Treatment group of patient	Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilonb		
						Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Group 1	factor1	0.098	40.458	9	0	0.633	0.738	0.25
Group 2	factor1	0.641	7.746	9	0.562	0.829	1	0.25
Group 3	factor1	0.501	12.04	9	0.213	0.725	0.869	0.25

TABLE 8. Test of within subjects effects for SART.

Treatment group of patient	Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Group 1	factor1	Sphericity Assumed	721.75	4	180.437	6.508	0
		Greenhouse-Geisser	721.75	2.531	285.193	6.508	0.002
		Huynh-Feldt	721.75	2.952	244.508	6.508	0.001
		Lower-bound	721.75	1	721.75	6.508	0.02
	Error (factor1)	Sphericity Assumed	2107.285	76	27.727		
		Greenhouse-Geisser	2107.285	48.084	43.825		
		Huynh-Feldt	2107.285	56.085	37.573		
		Lower-bound	2107.285	19	110.91		
Group 2	factor1	Sphericity Assumed	859.061	4	214.765	15.696	0
		Greenhouse-Geisser	859.061	3.316	259.042	15.696	0
		Huynh-Feldt	859.061	4	214.765	15.696	0
		Lower-bound	859.061	1	859.061	15.696	0.001
	Error (factor1)	Sphericity Assumed	1039.864	76	13.682		
		Greenhouse-Geisser	1039.864	63.01	16.503		
		Huynh-Feldt	1039.864	76	13.682		
		Lower-bound	1039.864	19	54.73		
Group 3	factor1	Sphericity Assumed	499.171	4	124.793	13.834	0
		Greenhouse-Geisser	499.171	2.898	172.228	13.834	0
		Huynh-Feldt	499.171	3.476	143.613	13.834	0
		Lower-bound	499.171	1	499.171	13.834	0.001
	Error (factor1)	Sphericity Assumed	685.57	76	9.021		
		Greenhouse-Geisser	685.57	55.068	12.45		
		Huynh-Feldt	685.57	66.04	10.381		
		Lower-bound	685.57	19	36.083		

TABLE 9. Estimated marginal means.

Treatment group of patient	factor1	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Group 1	1	19.198	1.678	15.687	22.709
	2	17.724	1.725	14.112	21.335
	3	16.931	1.808	13.146	20.716
	4	19.813	1.61	16.445	23.182
	5	24.625	1.319	21.864	27.387
Group 2	1	15.631	0.934	13.678	17.585
	2	17.54	1.196	15.036	20.044
	3	21.286	1.313	18.538	24.033
	4	21.288	1.045	19.1	23.475
	5	23.814	1.287	21.12	26.507
Group 3	1	16.914	1.166	14.474	19.355
	2	18.474	0.758	16.887	20.061
	3	20.918	0.979	18.869	22.967
	4	21.996	0.825	20.27	23.723
	5	22.93	0.727	21.409	24.451

TABLE 10. Within subjects factors AKET.

Descriptive Statistics

Treatment group of patient		Mean	Std. Deviation	N
Group 1	aketpre1	123.058	5.69371	20
	aket11	127.191	3.9301	20
	aket22	129.354	3.53312	20
	aket33	131.546	5.18087	20
	aket44	133.418	4.80021	20
Group 2	aketpre1	125.4415	5.50883	20
	aket11	128.502	4.90962	20
	aket22	132.3475	5.26297	20
	aket33	134.299	6.3135	20
	aket44	136.598	4.69836	20
Group 3	aketpre1	128.186	5.37373	20
	aket11	130.7225	3.39649	20
	aket22	134.881	3.07457	20
	aket33	136.061	3.00132	20
	aket44	138.204	3.68322	20

TABLE 11. One way ANOVA Straight Leg Raise Test.

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Group 1	20	89.36	2.42	0.541	88.23	90.5	84	95
Group 2	20	89.9	9.474	2.118	85.46	94.33	63	105
Group 3	20	93.51	9.615	2.15	89.01	98.01	77	108
Total	60	90.92	8	1.033	88.86	92.99	63	108

The table shows that difference of the straight leg raise test remained insignificant between treatment groups and within groups with a value of 0.206.

There was a statistically insignificant difference between groups for change in straight leg raising as determined by one-way ANOVA ($F(2,57)=1.623$, $p=0.206$). A Tukey post hoc test revealed that improvement in SLR was significantly after treatment as compared to pretreatment stages but there was no statistically significant difference between the groups ($p=0.206$) **(TABLES 13-18)**.

TABLE 12. Difference of straight leg raise test remained insignificant between treatment groups and within groups with value of 0.206.

ANOVA					
Straight leg raising fouth session value					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.t**
Between Groups	203.423	2	101.711	1.623	0.206
Within Groups	3572.881	57	62.682		
Total	3776.304	59			

TABLE 13. Post Hoc tests (Multiple Comparisons).

Multiple Comparisons						
Dependent Variable: Straight leg raising fourth session value						
Tukey HSD						
(I) Treatment group of patient	**(J) Treatment group of patient**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Group 1	Group 2	-0.534	2.504	0.975	-6.56	5.49
	Group 3	-4.146	2.504	0.231	-10.17	1.88
Group 2	Group 1	0.534	2.504	0.975	-5.49	6.56
	Group 3	-3.611	2.504	0.326	-9.64	2.41
Group 3	Group 1	4.146	2.504	0.231	-1.88	10.17
	Group 2	3.611	2.504	0.326	-2.41	9.64

TABLE 14. Homogeneous Subsets.

straight leg raising forth session value		
Tukey HSD[a]		
Treatment group of patient	**N**	**Subset for alpha=0.05**
		1
Group 1	20	89.36
Group 2	20	89.9
Group 3	20	93.51
Sig.		0.231
Means for groups in homogeneous subsets are displayed. a. Uses Harmonic Mean Sample Size=20.000		

TABLE 15: One way sit and reach test.

Descriptives								
Sit and reach test after 4th session								
	N	**Mean**	**Std. Deviation**	**Std. Error**	**95% Confidence Interval for Mean**		**Minimum**	**Maximum**
					Lower Bound	**Upper Bound**		
Group 1	20	24.6253	5.90005	1.31929	21.864	27.3866	14.22	34.29
Group 2	20	23.8136	5.75489	1.28683	21.1202	26.507	11.43	38.05
Group 3	20	22.9301	3.24912	0.72653	21.4094	24.4507	17.33	30.48
Total	60	23.7897	5.07568	0.65527	22.4785	25.1009	11.43	38.05

TABLE 16: One way sits and reach test between treatment groups and within groups.

ANOVA					
sit and reach test after 4th session					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	28.755	2	14.378	0.55	0.58
Within Groups	1491.237	57	26.162		
Total	1519.992	59			

TABLE 17: Post Hoc Tests (sit and reach test).

Multiple Comparisons						
Dependent Variable: sit and reach test after 4th session						
Tukey HSD						
(I) Treatment group of patient	**(J) Treatment group of patient**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Group 1	Group 2	0.81169	1.61747	0.871	-3.0806	4.704
	Group 3	1.69523	1.61747	0.55	-2.1971	5.5875
Group 2	Group 1	-0.81169	1.61747	0.871	-4.704	3.0806
	Group 3	0.88354	1.61747	0.849	-3.0088	4.7758
Group 3	Group 1	-1.69523	1.61747	0.55	-5.5875	2.1971
	Group 2	-0.88354	1.61747	0.849	-4.7758	3.0088

TABLE 18: Homogeneous Subsets (sit and reach test).

sit and reach test after 4th session		
Tukey HSD[a]		
Treatment group of patient	**N**	**Subset for alpha=0.05**
		1
Group 3	20	22.9301
Group 2	20	23.8136
Group 1	20	24.6253
Sig.		0.55

Means for groups in homogeneous subsets are displayed. a. Uses Harmonic Mean Sample Size=20.000.

The table shows that difference of the active knee extension test remained significant between treatment groups and within groups with a value of 0.04 **(TABLES 19-22)**.

Observations

■ Within groups

A repeated-measures ANOVA with a Greenhouse-Geisser correction determined that mean SLR differed statistically significantly for group A and C while insignificantly for group B, at the end of the treatment ($F(2.034, 38.653)=54.05$, $p<0.05$) for group A, ($F(3.115, 59.182)=11.739$, $p>0.05$) for group B, and ($F(2.707, 51.433)=8.076$, $p<0.05$.

A repeated-measures ANOVA with a Greenhouse-Geisser correction determined that mean sit and reach test differed statistically significantly for all C groups, at the end of the treatment ($F(2.531, 48.084)=6.508$, $p<0.05$) for group A, ($F(3.316, 63.010)=15.696$, $p>0.05$) for group B, and ($F(2.898, 55.068)=13.834$, $p<0.05$.

A repeated-measures ANOVA with a Greenhouse-Geisser correction determined that mean AKET differed statistically significantly for group A and C while insignificantly for

TABLE 19. One-way active knee extension test.

Descriptives

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Group 1	20	133.418	4.80021	1.07336	131.1714	135.6646	121.76	141.7
Group 2	20	136.598	4.69836	1.05059	134.3991	138.7969	128.46	145
Group 3	20	138.204	3.68322	0.82359	136.4802	139.9278	133	144.01
Total	60	136.0733	4.7875	0.61806	134.8366	137.3101	121.76	145

TABLE 20. Difference of active knee extension test remained significant between treatment groups and within groups with value of 0.04.

ANOVA

aket44	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	237.316	2	118.658	6.066	0.004
Within Groups	1114.972	57	19.561		
Total	1352.288	59			

TABLE 21. Post Hoc Tests (aket44).

Multiple Comparisons

Dependent Variable: aket44

Tukey HSD

(I) Treatment group of patient	(J) Treatment group of patient	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Group 1	Group 2	-3.18	1.3986	0.068	-6.5456	0.1856
	Group 3	-4.78600*	1.3986	0.003	-8.1516	-1.4204
Group 2	Group 1	3.18	1.3986	0.068	-0.1856	6.5456
	Group 3	-1.606	1.3986	0.489	-4.9716	1.7596
Group 3	Group 1	4.78600*	1.3986	0.003	1.4204	8.1516
	Group 2	1.606	1.3986	0.489	-1.7596	4.9716

*: The mean difference is significant at the 0.05 level.

TABLE 22. Homogeneous Subsets (aket44).

aket44

Tukey HSD[a]

Treatment group of patient	N	Subset for alpha=0.05	
		1	2
Group 1	20	133.418	
Group 2	20	136.598	136.598
Group 3	20		138.204
Sig.		0.068	0.489

Means for groups in homogeneous subsets are displayed. a. Uses Harmonic Mean Sample Size = 20.000.

group B, at the end of the treatment ($F(2.98, 56.620)=27.581$, $p<0.05$) for group A, ($F(3.068, 58.287)=21.282$, $p>0.05$) for group B, and ($F(2.412,45.833) =51.255$, $p<0.05$.

■ Between Groups

There was a statistically insignificant difference between groups for change in straight leg raising as determined by one-way ANOVA ($F(2,57)=1.623$, $p=0.206$). A Tukey post

hoc test revealed that improvement in SLR was statistically significant after treatment as compared to pretreatment stages but there was no statistically significant difference between the groups (p=0.206).

There was a statistically insignificant difference between groups for change in sit and reach rest as determined by one-way ANOVA (F(2,57)=0.550, p=0.580). A Tukey post hoc test revealed that improvement in sit and reach test was statistically significant after treatment as compared to pretreatment stages but there was no statistically significant difference between the groups (p=0.580)

There was a statistically significant difference between groups for change in active knee extension as determined by one-way ANOVA (F(2,57)=6.066, p=0.004). A Tukey post hoc test revealed that improvement in active knee extension was statistically significant after treatment for group A as compared to group C (p=0.003). there was no significant difference between group A and group B (p=0.068) and group B and group C (p=0.489)

Discussion

The purpose of this study was to see the effects of PNF hold relax hamstring stretch and METS so that flexibility of hamstrings can be improved.

In this study 60 males were taken, the subjects were allocated to three groups, Group A who received PNF hold relax stretching, Group B who received METS post isometric relaxation, and Group C who receive METS autogenic inhibition. Three scales were used to test the significance of the results. These include the Active knee extension test, Straight leg Raise, Sit and Reach test. Observations were taken before and after the treatment sessions. Based on results, it was shown that Group A had more pronounced effects of treatment as compared to Group B and Group C [8-16].

GROUP A, B, and C showed the significance of results with the calculated value of 0. In the activation knee extension test. The value for straight leg raise was 0.000. For Sit and Reach test, the values were the ere same for Group A and B that is 0.000, and for group C value 0.001 was else significant. These results showed that there is a significant difference between the three treatment groups [17-21].

Group B and C showed insignificant results with the calculated value of 0.206 for SLR and 0.580 for SART but Group A showed with the calculated value of 0.03 for AKET a significant value. This result showed that there is a significant difference between Group A From Group B and C which shows that Group A is a more effective treatment Group.

A blinded randomized design of the study was conducted to see the effect of static stretching of muscles surrounding the knee on knee joint position sense. Joint position sense in 45 degrees of knee flexion was improved to a great extent [13].

A randomized control trial on 48 subjects was conducted to find the effects of two different stretching techniques on ROM, balance, and muscle activation. Both the techniques showed a significant increase in knee extension angle.

Some studies also showed that there is no effect of stretching on the tightness and flexibility of the muscles. An RCT was conducted to see the effects of stretch on the extensibility of muscles and tolerance of stretch with patients of chronic MSK pain. It was concluded that stretch did not improve the extensibility of muscles but it increased tolerance to stretch of muscles [11].

Stretching is associated with a composite and multifactorial relation with a hamstring strain. It can be more beneficial if the technique used and the time duration for holding stretches are adequate. The repetitions are not as much important as time duration [22].

A study of static stretching and proprioceptive neuromuscular facilitation stretch on hamstrings length after a single session was conducted. This study showed that there was a significant increase in knee extension after applying static stretch and proprioceptive neuromuscular technique in a single session. A marked difference in ROM was observed in the control group and the other group [23].

Many studies showed that there is an equal effect of static stretching and hold relax on the hamstring. Similarly, PNF stretching has also an effect on hamstrings. All three techniques have the same effect but out of all PNF stretching hold relax has a more pronounced effect [3].

So it was concluded that stretching techniques

have significant effects on muscle flexibility and range of motion. Different techniques are used to achieve the effects of improved extensibility of hamstrings. Static stretching in the form of PNF hold relax was more significant as compared to other stretching techniques like self-stretching, ballistic stretching, etc.

Conclusion

It is concluded from the study that PNF hold relax technique on hamstrings in males with hamstring tightness is a significant treatment outcome on AKET. Males with hamstring tightness, when treated by PNF hold relax showed a significant result treatment outcome when analyzed on AKET, SLR, SIT AND REACH TEST. GROUP B and C showed a significant difference between pre and post-treatment session but there are insignificant results between the two Groups as value are ($p>0.05$) that is 0.206 on SLR and 0.580 on SART respectively.

Recommendations and limitations

The limitations of this study were that it was conducted in a single Department. It was not funded. The time duration was very limited to complete it. The sample size was low as it had to be completed in a short period. Loss to follow up was present which was less than 10% who had little effect on result findings.

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