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Effects of Muscle Energy techniques in Hamstring Flexibility

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ABSTRACT: The purpose of this research is to do a comparative analysis on the effects of two different Muscle Energy Techniques in improving hamstring flexibility. A quasi-experimental study was undertaken, using a sample of 48 people exhibiting hamstring tightness. The participants in this study were recruited and thereafter allocated randomly to one of two groups: the Post Isometric Relaxation (PIR) group and the Reciprocal Inhibition (RI) group. The selection of participants was conducted from specific places within the Salem district of Tamil Nadu, India. The study included three outcome measures, namely passive knee extension (PKE), sit and reach test, and stand and reach test. The evaluation of outcome measures was performed at two distinct time intervals: a duration of two weeks and a duration of four weeks subsequent to the implementation of the intervention. The results of the study revealed a significant improvement in hamstring flexibility during passive knee extension (PKE) for both experimental groups, starting at the two-week time point. However, the other two assessed outcomes shown improvement individually after a four-week intervention period. A significant discrepancy was seen between the two groups throughout the course of a two-week and four-week intervention period, with all three outcomes indicating a predilection for the PIR group. The current study shows empirical evidence suggesting that the use of Muscle Energy Technique (MET) has a positive impact on the improvement of hamstring flexibility. However, the findings indicate that Post-Isometric Relaxation (PIR) produces more favourable results when compared to Reciprocal Inhibition (RI) in both the immediate (2 weeks) and short-term (4 weeks) timeframes.

Keywords: Hamstring Injuries, Inhibition techniques, Muscle energy.

INTRODUCTION

The occurrence of hamstring strain is often seen among those involved in sports. In addition to their prevalence, these injuries provide significant challenges and frustrations for both patients and healthcare professionals, particularly due to their propensity for frequent recurrence. Historically, the emphasis on quadriceps strengthening has overshadowed the attention devoted to hamstring development, which has mostly been approached from a flexibility perspective. Hamstring strains constitute around 12-16% of all muscle injuries, and they have a reoccurrence rate ranging from 22-34%. In addition, it has been shown that recurring hamstring strains lead to much greater time loss compared to first hamstring strains (Brooks *et al.*, 2006; Orchard and Seward 2002). Numerous risk factors have been discerned in the extant literature pertaining to hamstring strains, (Watsford *et al.*, 2010) encompassing: The primary concern lies in the diminishment of flexibility concern (Watsford *et al.*, 2010). Strength deficits have been observed to exhibit a correlation with hamstring injuries (Orchard *et al.*, 1997) particularly when they coincide with a dearth of flexibility, a history of muscle fatigue (Sherry and Best 2004) inadequate core stability, insufficient warm-up routines prior to games (Worrell, 1994), improper lumbar posture, and a previous occurrence of hamstring injury (Hennessey and Watson 1993). All factors that predispose to a recurrence of hamstring injury must be considered. In stark juxtaposition to the notable prevalence of hamstring injuries observed among athletic individuals, a dearth of concrete delineation persists regarding the frequency of such injuries within the broader populace partaking in recreational sports and non-athletic pursuits (Engebretsen *et al.*, 2010).

The dearth of data is most pronounced among female persons and older adults who seek treatment for hamstring tears in general clinics, physiotherapy facilities, and orthopaedic clinics. Frequently, individuals with this condition are subject to misdiagnosis or get treatment mostly consisting of painkillers and rest, resulting in a tendency towards underdiagnosis. Patients who have a hamstring injury in the context of sports predominantly exhibit symptoms throughout their second and third decades of life (Konan and Haddad 2010; Cooper and Conway 2010).

On the contrary, it is worth noting that the demographic spectrum of individuals afflicted by hamstring injuries, who do not engage in athletic pursuits, exhibits a significantly wider span, encompassing those aged 60

years and beyond (Hernesman *et al.*, 2003; LaBan and McNeary 2008).

There exist a range of interventions that may be used for the care of hamstring injuries, including techniques such as passive and active stretching, strengthening exercises, plyometric training, and others. Numerous manual procedures have been used in the care of hamstring injuries, among which the muscular energy technique (MET) stands out as a distinctive intervention. Muscle Energy Technique (MET) involves the use of a muscle's inherent energy, which is produced by mild isometric contractions. This technique aims to induce muscular relaxation by means of autogenic or reciprocal inhibition, ultimately resulting in muscle lengthening. In contrast to conventional static stretching, Muscle Energy Technique (MET) is an active therapeutic approach in which the patient actively engages as a participant. The fundamental ideas behind Muscle Energy Technique (MET) are Autogenic Inhibition and Reciprocal Inhibition. Autogenic Inhibition, colloquially referred to as post-isometric relaxation (PIR), pertains to the occurrence whereby a sub-maximal muscular contraction is subsequently followed by the passive elongation of said muscle. Conversely, the phenomenon of Reciprocal Inhibition (RI) manifests itself when a muscle undergoes a submaximal contraction, subsequently succeeded by the passive elongation of the antagonistic group of muscles (Kang *et al.*, 2023). A comparative analysis was conducted on the impact of two different manoeuvres on hamstring flexibility in a sample of young, healthy Indian people. The results indicated that both manoeuvres were helpful in enhancing hamstring flexibility. However, it was observed that the Post-Isometric Relaxation (PIR) technique had greater therapeutic benefits compared to the other manoeuvre. The principal objective of the current study was to undertake a comparative examination of these two therapeutic modalities (Agrawal, 2016).

MATERIAL AND METHODS

A quasi-experimental design was used to test the research hypothesis. The investigation employed a one-to-one allocation ratio. The selection of participants was conducted from a diverse array of seven distinct sites situated within the Salem district, which is geographically positioned in the state of Tamil Nadu, India. The women who were chosen for this study had a prior occurrence of tightness in their hamstring muscles. Additionally, they were assessed to be in good physical and mental health and fell between the age range of 35 to 45 years. The parameter employed for evaluating the degree of hamstring tightness was established as a passive knee extension angle exceeding 19.2 degrees. Individuals with prior hamstring injuries, a history of lower limb and back surgeries, or any degenerative conditions affecting the lower limb were deemed ineligible for inclusion in the study.

The participants were further disqualified if they had ever engaged in professional sports. Each participant received a detailed explanation of the research, including information on the study's length and the amount of engagement necessary. Subsequently, participants were asked to provide their informed consent by signing a consent form. The participants had an initial assessment within the community. The research comprised individuals who had provided informed permission prior to their inclusion. The visitation might take place either in the patient's home or at a designated community screening facility. The selection of the treatment site for future care was determined by considering the patient population from a certain geographical region. Participants were extended an invitation to the Department in cases where the subject count was below a certain threshold. However, if the number of patients exceeded four, a therapist would come to the patient's location to provide therapy. It is important to note that treatment was provided on an individual basis.

The individuals were recruited using convenience sampling method from the population, after the screening of 166 people from specific areas within the Salem region. A cohort of 48 individuals was selected in accordance with their adherence to the predetermined criteria for inclusion. The individuals involved in the study were assigned to two distinct cohorts, namely the PIR group and the RI group, employing a randomised allocation methodology. A tabular structure was meticulously crafted with the aid of sophisticated computer software, while a clever strategy was implemented to conceal the sequential arrangement. An opaque cover was deftly employed to obscure the order until appropriate interventions were assigned. The individuals comprising the PIR group partook in a preliminary exercise session of approximately 10 to 12 minutes, interspersed with intermittent periods of rest. The warm-up exercises consisted of a marching movement performed while standing, with the upper limbs extending outward. b) Performing a stride forward and backward from a standing posture while extending the upper limbs forward. c) Executing a lateral stride from the upright stance and returning to the original posture while extending both upper extremities laterally. Following the completion of warm-up activities, the Post Isometric Relaxation Technique was administered to the hamstring muscle. The therapeutic modality was applied bilaterally to the lower appendages.

The individuals were situated in a supine reclined position, wherein the hip and knee on the opposite side were upheld by a cushion positioned beneath the knee. The therapist positioned themselves next to the leg requiring post-isometric relaxation. The hip joint is flexed at an angle of 90 degrees, whereas the knee joint is in a state of complete flexion. Subsequently, the knee joint underwent extension until the point at which the limitation barrier was discerned. Next, the leg was positioned on the therapist's shoulder, and the patients were instructed to engage the muscle at a submaximal level by exerting downward pressure on the therapist's shoulders. Simultaneously, the therapists provided a submaximal resistance, acting as a counterforce. The contraction is maintained for a duration of 7-10 counts,

followed by a subsequent relaxation period of 10 counts. Subsequently, the limb underwent passive manipulation by the therapists, leading to the identification of a new obstacle. Subsequently, the aforementioned technique was replicated starting from the recently established barrier. The procedure was administered on six occasions. The identical methodology was reproduced for the alternate extremity. The therapeutic modality was implemented on a daily basis, spanning six days per week, over a consecutive duration of four weeks, encompassing both hemispheres (Waxenbaum and Lu 2022).

The individuals comprising the RI group partook in a preliminary activity of approximately 10 to 12 minutes in duration, akin to the warm-up regimen undertaken by the PIR group. After the initial warm-up routine, the hamstring muscle underwent a process known as reciprocal inhibition. The therapeutic modality was applied bilaterally to the distal appendages. The individuals were situated in a supine reclined position, wherein the hip and knee on the opposite side were upheld by a cushion positioned beneath the knee. The therapist strategically positioned themselves in close proximity to the leg necessitating post-isometric relaxation. The hip joint exhibits a flexion of precisely 90 degrees, while the knee joint is observed to be in a state of complete flexion. Following a series of events, the knee joint proceeded to undergo extension until the precise moment at which the barrier of limitation became perceptible. Subsequently, the inferior appendage was strategically placed upon the therapist's shoulder, prompting the patient to engage in a suboptimal yet deliberate muscular contraction, exerting an upward force in a direction that diverges from the therapist's shoulder. Concurrently, the therapist administered a submaximal resistance in a counteracting direction. Consequently, there was a manifestation of the contraction of the knee extensors and hip flexors, acting as the antagonistic musculature in relation to the hamstring muscle. The muscular contraction is sustained for a span of 7 to 10 units of measurement, subsequently succeeded by a subsequent phase of relaxation lasting 10 units of measurement. Following the aforementioned events, the limb underwent another round of passive manipulation administered by the therapists, resulting in the discernment of a novel obstacle. Following the aforementioned procedure, the aforementioned technique was duplicated utilising the newly implemented obstacle. The aforementioned procedure was conducted on six separate instances. The identical methodology was replicated for the alternate appendage. The therapeutic intervention was implemented on a daily cadence, spanning six days per week, over the course of a continuous four-week period for both hemispheres (Waxenbaum and Lu 2022).

The study employed a multitude of outcome measures in order to evaluate diverse facets pertaining to the flexibility of knee extension. These measures encompassed the utilisation of passive knee extension in a supine position, thereby quantifying the extent of motion and serving as a reliable indicator of the flexibility of the hamstring muscles. Furthermore, the utilisation of the sit and reach test and the stand and reach test served as means to assess the functional range of motion, with a particular focus on the extension of the knee joint and the flexibility of the hamstring muscles. The outcome measures were evaluated prior to the implementation of the intervention, subsequent to a two-week duration of intervention, and upon the culmination of the fourth week of intervention.

The statistical computations pertaining to the investigation were executed utilising the software programme SPSS, specifically version 25. The utilisation of the chi-square test was employed in order to ascertain the fundamental uniformity of the demographical data. The utilisation of the independent t-test was employed in order to ascertain and evaluate the disparity that exists between the distinct groups under consideration. The notion of recurrent measurements pertains to a research paradigm wherein the identical participants are subjected to numerous instances of measurement, either on multiple occasions or within distinct contextual circumstances. The present study employed an Analysis of Variance (ANOVA) to discern the variances between groups, with a subsequent implementation of the Bonferroni test for post hoc analysis in the event that a statistically significant disparity was identified by the ANOVA. The study upheld a significance threshold of 0.05 and a confidence interval of 95% in its analysis.

Table 1: The fundamental demographic information pertaining to the participants in both groups.

Criteria	PIR Group	RI Group
Age	41 (1.2)Years	39 (2.1) years
Height	158 (4.2) cms	1.57 (3.3) cms
Weight	78 (8.4) Kgs	80.2 (7.5) Kgs
BMI	29.2 (1.4)	30.9 (1.1)
Work	Housewife-18	Housewife-18
	Employed-6	Employed-11

RESULTS AND DISCUSSION

A comprehensive evaluation was conducted on a collective of 166 individuals to determine their suitability for participation in the research endeavour. Following a rigorous assessment, it was determined that 48 individuals met the necessary requirements and were subsequently admitted into the study. The individuals involved were subsequently allocated in a random manner to two distinct cohorts. Table 1 showcases the essential demographic data pertaining to the individuals encompassed within both groups. The chi-square analysis performed on the demographic data unveiled no statistically significant disparities between the two cohorts concerning age, which was discretized into two distinct groups: 35-40 years and 41-45 years (chi-square value = 0.6, p-value = 0.438). In a similar vein, it is worth noting that no substantial disparities were detected in terms of height ($\chi^2 = 0.68$, $p = 0.401$), weight ($\chi^2 = 0.76$, $p = 0.228$), and BMI ($\chi^2 = 0.59$, $p = 0.799$).

Upon initial assessment of the pre-test value, no discernible disparity of statistical significance was observed between the two cohorts across the entirety of the three outcome measures. The PKE-F examination resulted in a F statistic of 0.111 and a corresponding p-value of 0.740. In a similar vein, the Sit and Reach test yielded a F value of 0.215 and a p value of 0.645. In conclusion, the Stand and Reach test yielded a F value of 0.156 and a p value of 0.694. Upon conducting a thorough analysis subsequent to the test, it was duly noted that a notable disparity in the outcome measure of PKE existed between the two distinct groups (PKE – F value = 10.645, p value = 0.002). Nevertheless, it is worth noting that there were no discernible disparities of consequence observed between the two cohorts in the sit and reach examination (F value = 1.533, p value = 0.222) as well as the stand and reach evaluation (F value = 1.278, p value = 0.264). The analysis of post-test 2 findings unveiled a statistically noteworthy discrepancy observed across all outcome indicators. The PKE examination produced a significant F statistic of 22.125, accompanied by a p-value of 0.001. In a similar vein, the Sit and Reach test yielded a F value of 5.180 and a p value of 0.028. In conclusion, the Stand and Reach test yielded a F value of 12.277 and a p value of 0.001.

The examination carried out by the collective for PKE yielded noteworthy findings, as evidenced by the presence of a statistically significant disparity observed across the three assessments in both the PIR group ($f = 199.741$, $p < .001$) and the RI group ($f = 163.642$, $p < .001$). The post hoc analysis, employing the Bonferroni test, revealed a statistically significant disparity among the three examinations, as evidenced by a p-value of 0.001. Table 2 presents the comprehensive statistical analysis pertaining to the descriptive measures of the PKE (Physical Kinetic Energy) for both cohorts.

Table 2: Comparison of PIR and RI groups descriptively using PKE scores.

Test		N	Mean	SD	SE	95% CI	
						Lower Bound	Upper Bound
PIR-PKE	Pre-Test	24	56.50	1.142	0.23313	56.0177	56.9823
	Post Test	24	60.87	2.070	0.42269	60.0006	61.7494
	Post Test 2	24	71.00	3.787	0.77319	69.4005	72.5995
	Total	72	62.79	6.622	0.78047	61.2355	64.3479
RI-PKE	Pre-Test	24	56.75	1.326	0.27087	56.1897	57.3103
	Post Test 1	24	59.87	1.392	0.28433	59.2868	60.4632
	Post Test 2	24	64.25	1.594	0.32554	63.5766	64.9234
	Total	72	60.29	3.408	0.40170	59.4907	61.0926

Table 3: Scores on the sit and reach test as a descriptive statistic for the PIR and RI groups.

Test		N	Mean	SD	SE	95% CI	
						Lower Bound	Upper Bound
PIR-SIT & REACH	Pre-Test	24	12.00	0.722	0.14744	11.6950	12.3050
	Post Test 1	24	14.00	0.510	0.10426	13.7843	14.2157
	Post Test 2	24	17.37	0.494	0.10095	17.1662	17.5838
	Total	72	14.45	2.30	0.27188	13.9162	15.0004
RI-SIT & REACH	Pre-Test	24	11.87	0.612	0.12500	11.6164	12.1336
	Post Test 1	24	12.75	0.442	0.09029	12.5632	12.9368
	Post Test 2	24	14.37	0.710	0.14512	14.0748	14.6752
	Total	72	13.00	1.19	0.14126	12.7183	13.2817

Table 4: Scores on the stand and reach test as a descriptive statistic for the PIR and RI groups.

Test		N	Mean	SD	SE	95% CI	
						Lower Bound	Upper Bound
PIR-STAND & REACH	Pre-Test	24	1.0625	0.473	0.09665	.8626	1.2624
	Post Test 1	24	2.2500	0.44	0.09029	2.0632	2.4368
	Post Test 2	24	4.6875	0.56	0.11583	4.4479	4.9271
	Total	72	2.6667	1.59	0.18817	2.2915	3.0419
RI-STAND & REACH	Pre-Test	24	1.0000	0.44	0.09029	0.8132	1.1868
	Post Test 1	24	1.5625	0.47	0.09665	1.3626	1.7624
	Post Test 2	24	2.2500	0.44	0.09029	2.0632	2.4368
	Total	72	1.6042	0.68	0.08031	1.4440	1.7643

The findings from the intra-group examination of the sit and reach assessment revealed a persistent pattern in both the PIR group ($f = 517.317$, $p < .001$) and the RI group ($f = 107.682$, $p < .001$). The post hoc analysis, employing the Bonferroni test, revealed a statistically significant differentiation among the three tests, with a p-value of 0.001. Table 3 presents the comprehensive statistical summary pertaining to the sit and reach test outcomes for both cohorts.

In the examination of the stand and reach test across various cohorts, a parallel pattern was observed in both the PIR group ($f = 331.478$, $p < .001$) and the RI group ($f = 45.848$, $p < .001$). The post hoc analysis, employing the Bonferroni test, revealed a statistically significant differentiation across all three examinations, as evidenced by a p-value of 0.001. Table 4 presents the descriptive statistics pertaining to the sit and reach test for both groups.

The objective of the present research was to examine the difference in the impacts of two often used MET approaches, namely PIR and RI. The research had a total of 48 individuals, with 24 patients enrolled into each group. The design of the study may be classified as quasi-experimental due to the easy selection of volunteers from the public. In order to mitigate bias, the allocation of patients was performed with a random selection approach. Upon conducting an initial analysis of the demographic data and outcome measures, it was observed that no statistically significant disparities existed between the groups. This observation implies that the groups were comparable in their characteristics prior to the implementation of the intervention. This discovery implies that any discernible alterations in the variables can be ascribed exclusively to the intervention, thus mitigating the impact of confounding variables.

The study employed three distinct outcome measures, wherein the PKE was utilised as a direct quantification of hamstring length, while the remaining two measures were considered functional indicators of hamstring length. Upon careful examination of the data pertaining to the end measures, it becomes evident that there is a discernible enhancement in the factual extension of the hamstrings over the initial fortnight of the intervention. Nevertheless, it is worth noting that a considerable span of four weeks was necessary for the functional range to manifest any discernible enhancement. This outcome holds significant significance within the confines of this particular study. The results suggest that the obtained outcomes were comparatively more favourable in relation to the previous findings of (Aquino *et al.,* 2010; de Weijer *et al.,* 2003).

One of the primary constraints of the research was the relatively small sample size and the absence of women from diverse backgrounds and a wide range of age groups. Due to a restricted level of involvement from senior ladies, the researcher was compelled to restrict the age range of the sample to those between 35 and 45 years old. The sit and stand reach test used in the research may be subject to confounding effects arising from lumbar spine stiffness, which might potentially impact participants' performance (Mayorga *et al.,* 2014).

CONCLUSIONS

This study's findings indicate that both interventions demonstrate efficacy in enhancing hamstring flexibility. However, it is seen that the Post-Isometric Relaxation (PIR) intervention yields greater results compared to the Reciprocal Inhibition (RI) intervention, both in the immediate (2 weeks) and short-term (4 weeks) periods. Further investigation is required to examine the long-term durability of these benefits after the discontinuation of the intervention. It is recommended that future studies use a larger sample size to enhance the generalizability of the findings.

FUTURE SCOPE

The future scope of this research encompasses many areas of investigation, including the examination of long-term impacts, the expansion of comparative analysis, the elucidation of underlying processes, the exploration of demographics, the establishment of maintenance procedures, the resolution of sample size issues, and the experimentation with intervention combinations. These study pathways would enhance our comprehension of the effects of treatments on hamstring flexibility and provide guidance for their implementation in diverse settings.

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Conflict of Interest. None.

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