Effects of Post-Isometric Relaxation on Hamstring Mobility Using Sit-and-Reach Test

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Abstract

Objectives: The purpose of this study was to evaluate the efficacy of post-isometric relaxation of hamstrings, specifically addressing the length of the muscle. Secondarily, this study looked at the relevance of the sit and reach test when looking at hamstring length and flexibility.

Methods: 26 Chiropractic students were randomly divided into two equal groups and tested for their flexibility in inches in the sit and reach test on day 1. The control group then rested for 5 minutes in a sitting position, and the experimental group had their hamstrings stretched with post-isometric relaxation. Both groups retested on the sit and reach test 5 minutes after the initial test. This procedure was repeated on days 3 and 5.

Results: The experimental group showed significant change in flexibility in performing a sit and reach test over the course of the study, while the control group did not have measureable change.

Conclusions: Post-isometric relaxation is an effective stretching technique for muscles, and can be associated with improvement in flexibility over the course of multiple treatments.

Key Terms: *Hamstrings, Post-isometric Relaxation, PIR, Flexibility, Hypertonic muscles*

Introduction

Hamstring flexibility is an important, but often over-looked factor in occurrence of low back pain and injury prevention. A study done by Liemohn on hamstring strains concluded that non-injured groups of muscle always tended to be more flexible than the injured groups.[1] Another study examining injuries in soccer players found that strains had occurred in 31% of the players with muscle hypertonicity but in only 18% of the players with normal flexibility.[2] Additionally, hamstring hypertonicity is correlated with increased occurrence of low back pain. People with tight hamstrings are forced to use more low back movement during forward bending, resulting in higher incidence of low back pain.[3] Hypertonic hamstrings were identified as one of five risk factors for low back pain in adolescence.[4]

The sit and reach test is a common measure of flexibility, and specifically measures the flexibility of the lower back and hamstring muscles.[5] It is a widely used in physical fitness testing, most notably in the Physical Fitness Test used in the Presidential Challenge, which is standard in elementary and secondary physical education throughout the United States.

Post-isometric relaxation is a technique that aims to aid in muscle relaxation. It begins by placing a muscle in a stretched position. Then the patient exerts an isometric contraction against minimal resistance, which is about 20% of their full strength. Relaxation and then gentle stretch follow as the muscle releases.[6] This process is repeated, with each pass allowing for greater stretch of the muscles before isometric contraction.

Methods

Study Design

The study was performed on 26 chiropractic students at Logan Chiropractic College. The subjects where randomly divided into two groups; one control group consisting of 13 subjects, and one experimental group consisting of 13 subjects. The aim of the study was to determine the effects of post-isometric relaxation (PIR) on hamstring flexibility. The study was carried out over a five-day period, with the patients reporting on the first, third, and fifth day for measurements. At each encounter, the patients performed a sit-and-reach test. The results were recorded in inches. The control group then rested in a chair for five minutes then performed the sit-and-reach test again. The results were recorded. After the initial measurements, the subjects in the experimental group had a series of three post-isometric relaxation stretches applied to each of their hamstrings. The patient then performed the sit-and-reach test 5 minutes after the initial test. The results were recorded. In this paper, Treatment will describe the PIR performed on the experimental group, and the timed rest for the control group.

Inclusion Criteria

Participants were between the ages of 20-40 and were attending Logan College of Chiropractic at the time of data collection. All of the patients denied any history of serious injury to their lower extremities.

Exclusions Criteria

Participants were excluded if they did not agree to sign the informed consent form, were pregnant, had a history of serious injury to their lower extremity, or had used muscle relaxants in the past year.

Data Collection

The test was performed with the subject removing their shoes and sitting on the floor with legs out straight ahead. The subject's feet were placed with the soles flat against the box, shoulder-width apart. Both knees were held flat against the floor. The subject would then, with hands on top of each other and palms facing down, reach forward along the measuring line as far as possible.

Equipment

A sit-and-reach box was used to record measurements. The sit and reach box is specifically designed to evaluate the flexibility of a selected set of joints and small muscles that include the lower back, hamstrings, and hip joints; all of which must work together to provide flexibility. The sit-and-reach box used in this study was made by Novel Products and measured in both inches and centimeters.

Ethical Considerations

This study received approval from the Institutional Review Board for ethical consideration (Ref IRB SR0806100258).

RESULTS

Twenty-six people presented to participate in the study. Two of those potential participants were excluded due to pregnancy, and four others failed to meet the full requirements of the study. Of the participants that qualified for the study, seven were female, and thirteen were male. These twenty participants represented 76.9% of the total participants invited to participate in the study. 35% of these participants were female, and 65% were male, and the average age of the participants was 25 years with a standard deviation of 3.99 years.

Table 1 describes the change measured in inches from pre to post treatment during each individual trial. This comparison is isolated within each trial. Figure 1 demonstrates the progression of pre and post change between each trial. This graph represents the data obtained within each trial compared within that trial (P=.034) (SD= .055 inches).

Table 2 describes the average change measured in inches from the initial treatment at the beginning of trial 1 to the pre treatment measurement taken at each trial. Figure 2 represents the data in table 2, and shows linear progression of the experimental group with increasing average improvement with each trial and non-linear progression with a smaller difference in the control group in each of the three trials (P=.056) (SD=.152 inches).

Table 3 demonstrates the average change from the initial measurement at the beginning of trial 1 to the post treatment measurements of each of the 3 trials. Figure 3 describes the data in table 3, and shows a linear progression of both control and experimental groups, however the experimental group demonstrates a faster progression and steeper curve than the control group. (P=.049) (SD= .134 inches).

Table 1. *Average Difference between Pre and Post treatment Measurements in each trial*

	Trial 1	Trial 2	Trial 3
Control	0.417	0.483	0.374
Experimental	0.641	0.509	0.65

Figure 1. *Average Difference between Pre and Post treatment measurements in each trial*

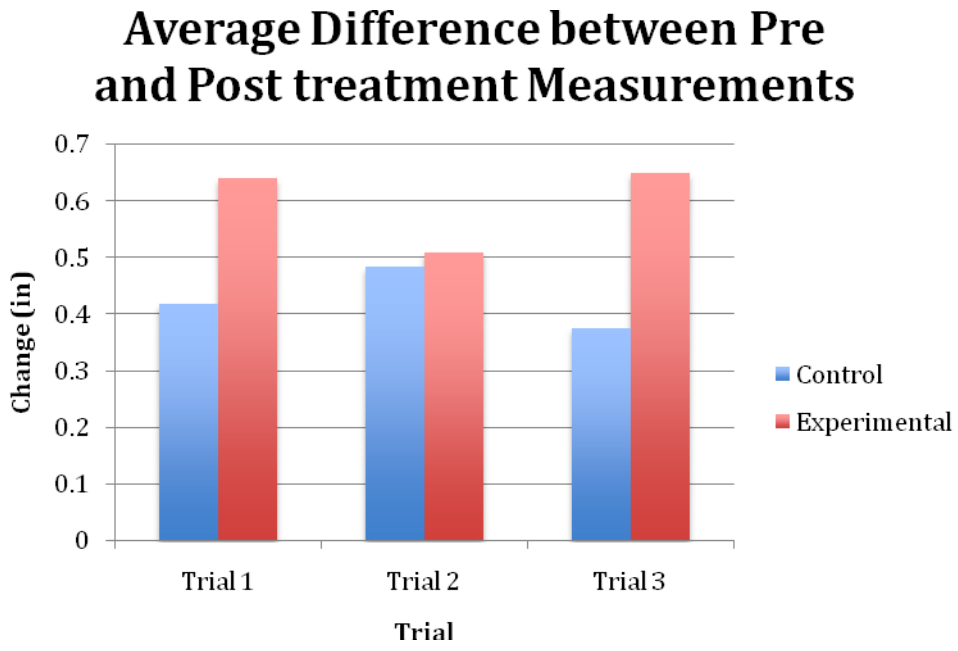


Table 2. *Average change from initial measurement to before each treatment*

	Trial 1	Trial 2	Trial 3
Control	0	-0.027	0.122
Experimental	0	0.409	0.568

Figure 2. *Average change from initial measurement to before each treatment*

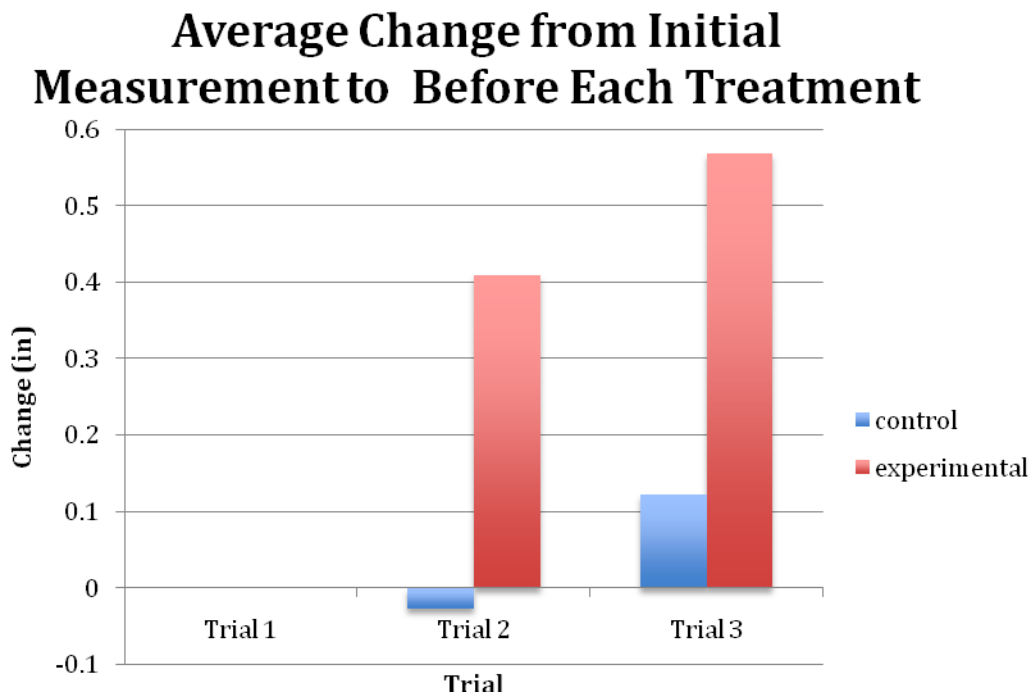
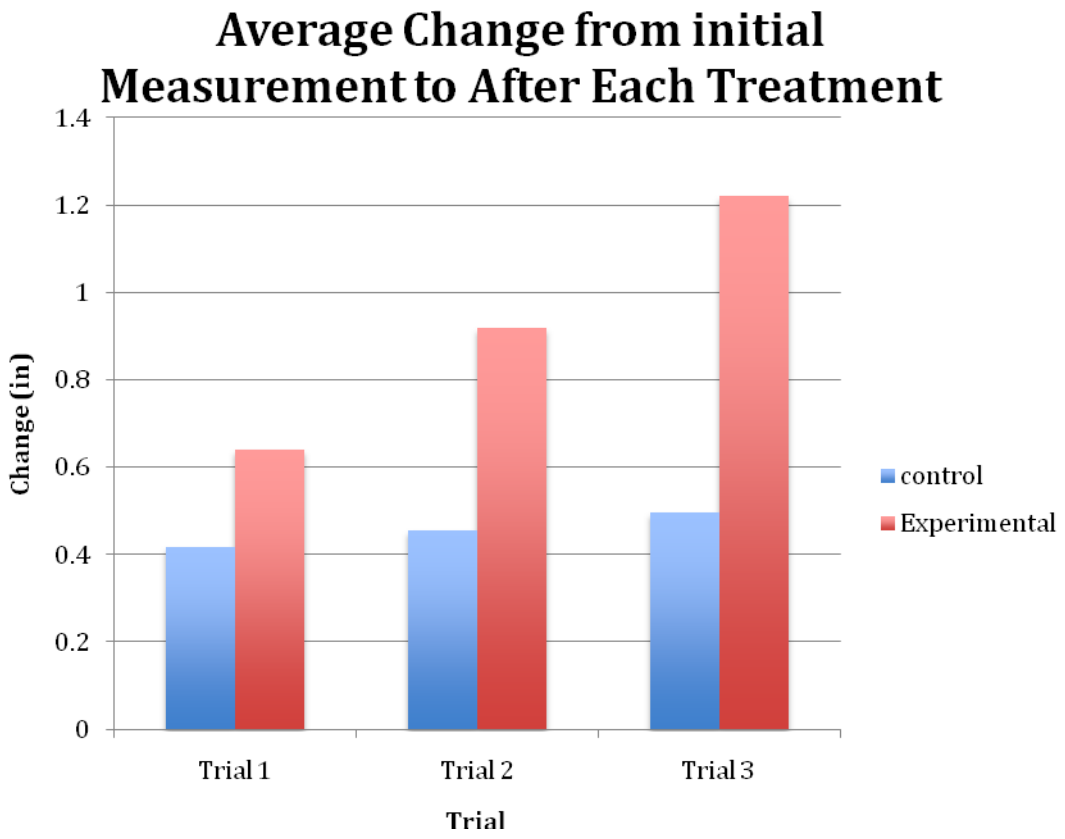


Table 3. *Average change from initial measurement to after each treatment*

	Trial 1	Trial 2	Trial 3
Control	0.417	0.456	0.496
Experimental	0.6409	0.918	1.22

Figure 3. *Average change from initial measurement to after each treatment*



Discussion

The sample in this study showed a measurable response to the PIR treatment over the duration of the study (P=.049), which is significant when compared to the control group in the study. As demonstrated in the graphical analysis of the data, the stretching does not seem to have immediate effect on the subject's flexibility in the sit and reach test when tested immediately afterward, however, over the duration of the study, it made a difference. Table 1 and figure 1 represent the change from before each trial to after the same trial. This evaluation is scattered and does not show a relationship between treatment and result within each trial, though it is considered statistically significant data (P=.034).

There was a relationship in the evaluation of the progression from the initial trial to the end of the study, represented in table 3 and figure 3. These data show a linear curve of improvement for the experimental group and a non-linear, scatter curve for the control as shown in figure 3.

The data in table and figure 2 represent the change between the pretreatment measurement of each trial and the initial measurement. This data has a high P-value (P=.056) and high Standard Deviation (SD= .152 inches) because the initial test and the Trial 1 pretest measurement are the same, which nullifies the statistical value, and the changes are smaller than the post treatment measurements, which makes the standard deviation more significant. This number was included in the graphical analysis because it is a good reference point for the other two trials.

After a phase of contraction, the muscle will show an increased flexibility due to a decreased resting tension; this is believed to be caused by post-contraction inhibition of α- motorneurons and/or by reduced motorneuron excitability.[7] Given that this was the basis of our study, we expected to see more drastic improvement from before to after each individual PIR treatment. Instead, our results showed a greater relationship between the PIR stretching and the clinical gains over the course of the treatment plan. The muscles that were stretched showed consistent improvement in each of the 3 trials, while the control showed variations, but were less than the experimental in all of the trials.

We found that after being stretched with post-isometric relaxation, the muscles were not significantly relaxed immediately, but did show mild change in flexibility over the course of 5 days. The curve shows the summation relationship with the muscles flexibility. None of the individual treatments showed significant improvement that was

greater than another, however, over the course of the experiment, the patients in the experimental group performed better on the sit and reach test each time, resulting in gradual improvement in their results over the 5 day experiment.

This data is relevant because it shows the importance of multiple, frequent treatments to obtain significant clinical improvement when using PIR as a treatment for hypertonic muscles.

This study is relevant because there is little known and understood about the physiology of muscle relaxation and fatigue, especially in regard to the nervous system. [8] Since we do not understand this process fully, our culture is bound by flexion dominant conditions such as upper crossed syndrome, which are the result of poor posture and the inability to effectively lengthen the muscles that are chronically hypertonic. [9] The study of muscle relaxation techniques is a necessary component in the future of healthcare. Our society is conditioned to a flexion dominant posture, which is leading to acceleration of degenerative processes in our society. If we continue to sit for 8 hours a day at computer terminals, shortening the muscles of flexion, and fail to strengthen the antagonistic muscles, it is essential that we develop consistent and effective methods to treat and possibly reverse the neurologic processes that lead to chronic muscle hypertonicity and myalgia.

Though there sample size is small, there is a distinct progression of the subjects who received stretching as compared to the control group.

Limitations

This study is a first step in a field of research that needs to be explored thoroughly. Limited availability of study subjects is a significant limiting factor in this

study. Though the data obtained it technically considered statistically significant, there were only 9 control subjects and 11 experimental subjects. This resulted in data that showed trends, but lacks the population to really measure the experiment effectively.

The method of data collection limits the accuracy of the measurement. This experiment needs a system that removes human error from the data collection method. A computerized measurement would provide more precise measurements, and eliminate the human error from the actual data collection.

The treatment period was a limiting factor. By limiting the treatment to only 3 trials, the experiment was unable to track the trends fully, specifically the peak at which improvement is no longer obtained, and the total amount of flexibility that can actually be gained through PIR stretching.

It is relevant to track the angle at which the supine subject is able to flex their hip to before treatment, including the control group, because it will provide data that can be broken into groups depending on pre-experiment flexibility.

This experiment also has the potential for placebo effect because control group was not provided with any type of sham treatment, we are unable to rule out the potential that the experimental group did not try harder after their stretch because they were under the belief that stretching should make them more flexible.

Finally, the act of performing the it and reach test provides stretch to the hamstring, so even the control group experience some level of hamstring stretch, which may explain the positive trend shown by the control in the post trial measurements.

The next experiment should include at least 50 participants in each group and use electronic measurement with the sit and reach test. The treatment should last a minimum

of 3 weeks, and the tension of the hamstrings should be measured using the angle of supine hip flexion before the treatment period begins. There should also be a sham treatment provided to the control group to eliminate the placebo effect.

Conclusions

The post-isometric relaxation is an effective stretching technique, and if used in a progressive treatment plan, results in increased muscle flexibility. The sit and reach test provides a good measurement, and can detect improvement in hamstring flexibility after PIR stretching.

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