

## RESEARCH REPORT

# Comparison of cyclic loading and hold relax technique in increasing resting length of hamstring muscles

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### KEYWORDS

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**Abstract** To evaluate and compare the effects of hold-relax technique and cyclic loading technique on increasing the resting length of hamstring muscles. This was a randomised intervention trial. The setting was an academic rehabilitation centre, which provided physical therapist assistant programs under the supervision of a biomechanics expert. Thirty-six healthy male subjects who exhibited bilateral hamstring muscle tightness (18–30 years of age) volunteered to participate in this study. For each subject, one leg was randomised to receive the hold-relax technique, whereas the other side received the cyclic loading technique. The treatment was applied every alternate day for 3 consecutive weeks. Stretching sessions were supervised by the biomechanics specialist. Measurements were taken before and after the 3-week treatment period by the same investigator, who was blindfolded to the allocation of treatment. The popliteal angle and stretch pain (measured by the visual analogue scale) were the two parameters considered. The analysis was done using the paired *t* tests. The results showed that both the hold relax and cyclic loading stretch produced significant difference in the popliteal angle and stretch pain ( $p < 0.001$ ). In conclusion the hold relax and cyclic loading hamstring stretches have comparable effectiveness in improving flexibility. Both produced similar and significant results.

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## Introduction

Flexibility is an important component of physical conditioning programs as an adjunct to muscle strengthening

and endurance training [11]. A shortened muscle may create imbalance in joints and faulty postural alignments that may lead to injury and joint dysfunction [12]. Clinical and basic investigators have proposed that a muscle that does not undergo periodic lengthening will develop a decreased resting length and reduced extensibility [13]. The hamstrings are example of muscle groups that have a tendency to shorten [1]. Many people suffer with tight hamstrings. Most of the time they will not cause

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a problem but can be more prone to bad tears, may contribute towards injuries, such as lower back pain and popliteal injury, and also may be limiting sporting performance.

Tight hamstrings can also be responsible for postural problems and other back problems, such as sacroiliac joint pain, as they will tend to pull the pelvis out of normal position. The “normal” range of hip flexion (measured when laying flat on your back and raising the leg straight off the floor—knee straight) permitted by the hamstrings is in the region is approximately 80°–90°. Anything less than 80° is considered “tight.” The prevention of deformity and the preservation of function are of major concern to the medical team; and to meet these goals, much time is spent on improving and/or maintaining a patient’s joint range of motion (ROM). Many methods of lengthening shortened soft tissues are available. The hold relax technique has been compared with several other stretching techniques and has been proven to be more effective in lengthening hamstring muscles. Similarly, cyclic loading has been proven to be more successful compared with other stretching techniques. The question now centres on, which method lengthens tight structures to the maximum limit [2]. The purpose of this study is to compare the effectiveness of hold-relax and cyclic loading technique, which are supposedly the best two stretching techniques, on tight hamstring muscles and thereby its impact of lengthening of the same.

## Methods

### Subject

Subject selection criteria included: (1) no history of traumatic and degenerative changes in the knee joint and previous injuries or low back disorders [3] and (2) popliteal angle less than 25°. To measure the popliteal angle, the active knee extension test was used (Fig. 1). First, the patient was placed in a supine position. The therapist stands on the side to be examined. The opposite limb was supported on a stool. The limb to be examined was passively flexed at the hip to 90° so that the femur comes perpendicular to the floor. The patient was asked to extend the knee until he was able to feel the stretch. The popliteal angle was measured. Zero degree was considered to be full extension of the knee [4].

A total of 36 subjects (males with age ranging from 18 years to 30 years) with bilateral hamstring tightness fulfilled the selection criteria. The subjects agreed that they would not engage in any other lower limb exercises programs apart from the one designed for this study during the stipulated period of 3 weeks. For each subject, one leg was randomised to receive the treatment using the hold-relax technique, whereas the other side underwent the treatment using cyclic loading technique, on alternate days for 3 consecutive weeks. Ethics approval was granted by the University. The procedure was adequately explained to the subjects before obtaining their informed consents. All experimental procedures were conducted in accordance with the Declaration of Helsinki.

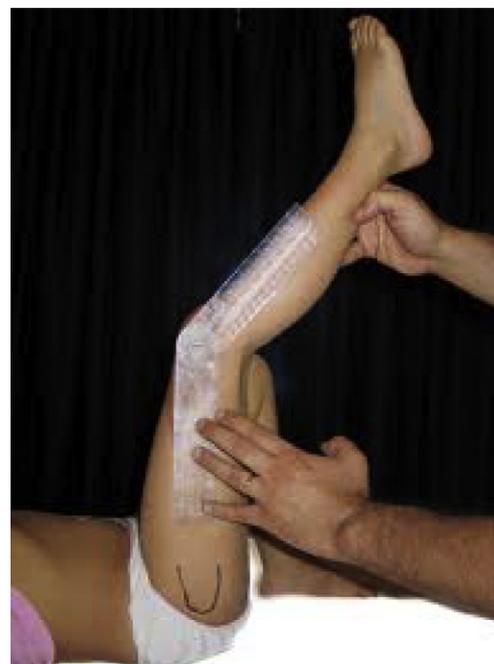


Figure 1 Popliteal angle measurement.

### Outcome measurement

Each subject was assessed before the initiation of treatment and again at the end of the 3-week treatment period. There were two outcomes of interest. First, the baseline knee extension deficiency (KED) was measured using a double-arm goniometer by recording the popliteal angle. The subject performed the active knee extension test procedure as described above. Each subject draped properly to avoid any restriction in movement. The greater trochanter, the head of fibula, and the lateral malleolus were marked with a felt-tipped pen and served as anatomical landmarks for the goniometric assessment. Second, the pain during stretch was determined through the visual analogue scale (VAS), which is universally accepted for pain measurement. The subjects were asked to indicate the level of pain by marking on the 10-cm line (0: no pain, 10: severe or unbearable pain).

### Stretching protocol

#### Hold relax

The limb to be treated was flexed at the hip to 90° and then extended at the knee till the tolerable limit [5]. At this position, an active hold relax was done by the patient by flexing his knee and thereby contracting the hamstrings and holding it for 10 seconds. The procedure was repeated 10 times by increasing the knee extension angle gradually. Treatment was given on every alternate day for 3 weeks.

#### Cyclic loading

The limb to be treated was flexed at the hip to 90° and then extended at the knee till the tolerable limit. It is held in this position for 10 seconds (critically comfortable period of time for muscle stretching) [10]. The procedure is repeated

**Table 1** Measurement of outcomes

Outcome	Hold relax			Cycling loading		
	Pretest	Posttest	<i>p</i>	Pretest	Posttest	<i>p</i>
ROM	43.6	27.4	<0.001	41.2	25.1	<0.001
VAS	7.6	4.1	<0.001	6.8	3.2	<0.001

ROM = range of motion; SD = standard deviation; VAS = visual analogue scale.

Mean (SD) is presented.

10 times by increasing the knee extension angle gradually. Treatment was given on every alternate day for 3 weeks.

### Data analysis

The statistical package for social science windows version was used for data analysis (SPSS Inc., Chicago, IL, USA). Descriptive statistics of mean range and standard deviation were computed on all the data. Paired *t* test was performed to compare the pre- and posttest ROM and VAS scores for each technique, with the significance level adjusted to 0.025 (Table 1).

### Results

After the treatment using the hold-relax technique, the KED (popliteal angle) was significantly reduced by 16.2° ( $p < 0.001$ ). The stretch pain was also significantly decreased by 3.5 points ( $p < 0.001$ ). On the other hand, after the treatment using the cyclic loading group, the two variables also demonstrated a significant reduction ( $p < 0.001$ ). Specifically, the KED and VAS score were reduced by an average of 16.1° and 3.6 points, respectively.

### Discussion

Flexibility is an important physiological component of physical fitness and reduced flexibility and can cause locomotive inefficiency and will perhaps be a risk factor for low back pain [6]. Mechanical stretching devices have been shown to increase ROM effectively in patients with selected pathologic restrictions. Direct clinical application of the findings in this study, however, must be made judiciously with the patient's subjective tolerance and overall medical status in mind. The strength of the patients' antagonist muscle and their overall activity level are important factors in determining the effectiveness of mechanical stretching. Variables, such as force, amplitude, duration of treatment, and cyclic versus hold relax treatment would depend on the individual situation [14].

The subjects in this study generally appeared to be more comfortable with the cyclic method as it did not have the active contraction portion. The mechanical properties of the tissue to be stretched should be considered when determining the force and amplitude settings. Caution should be used when connective tissue weakness is suspected (e.g. as in subjects with rheumatic disease,

prolonged steroid therapy, or recent surgical wounds). Patients with connective tissue weakness should be monitored continually with gentle initial force settings. Conversely, athletes with well-established scars may benefit from more vigorous treatment. Mechanical devices may save the therapist considerable time and energy when treating patients with ROM deficits. Increasing hamstring flexibility was reported to be an effective method for increasing hamstring muscle performance on selective isokinetic conditions [7]. Studies have been done in the past comparing cyclic loading technique and hold-relax technique with other stretching techniques. Another study compares hold-relax procedure and passive mobilisation, which showed that hold relax produces better results [8]. Another study compares cyclic loading and sustained passive stretching, which showed that cyclic loading produced better results [9]. This study was aimed to determine whether hold-relax or cyclic loading was more effective and the results showed that both of these techniques produced comparable results on improving hamstrings flexibility and reducing pain.

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