

## Effect of PNF Versus Cyclic Stretching in Tendo-Achilles Tightness among College going Girls of Nashik

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### Abstract

*Context:* Tendo Achilles tightness is the most common problem in normal healthy individuals who wear high heels or sit for prolonged period of time which also leads to calf muscle tightness. Stretching is a form of physical exercise in which a specific muscle or tendon (group of muscles) which are shortened are target for its lengthening. The muscles or tendon is stretched in order to improve its flexibility and elasticity and reduce tightness and achieve normal range of motion which is being restricted due to that tightness. *Aim:* Purpose is to compare the effectiveness of Cyclic stretching versus PNF stretching in TA tightness. *Setting and Design:* 40 healthy individuals (n= 40) between 18 to 25 years (female) with TA tightness were randomly divided into two groups equally. Each group consists of 20 subjects. *Methods and Material:* Ankle dorsiflexion of affected side was measured using universal goniometer. Subjects in group A were treated with PNF stretching and subjects in group B were treated with Cyclic Stretching. Treatment was given for 7 days on daily basis. Post treatment ankle dorsiflexion was recorded and compared. *Statistical analysis used:* After the intervention, difference between the groups was compared using paired t Test and between the group it was compared using Unpaired T Test. *Results:* The PNF technique (group A) the value of ankle dorsiflexion was increased at the end of 7<sup>th</sup> day (19) compared to baseline value (12.15). *Conclusions:* Both the PNF and Cyclic stretching techniques are effective in improving TA flexibility and improving ankle range of motion, but PNF is more effective compared to cyclic stretching in reducing TA tightness.

**Keywords:** PNF stretching, Cyclic Stretching, Tendo- Achilles tightness, flexibility

### Introduction

Stretching is a therapeutic technique used to lengthen pathologically shortened soft tissue & to improve range of motion.<sup>1</sup> Factors that play an important role neurologically are proprioceptors & golgi tendon organ. The nerve endings that

send all the information about muscle and joint position in skeletal system to CNS are called as proprioceptors. It detects any change in physical displacement & rate of change in tension or force within body. Flexibility reduces the chances of injury, the reduction of soreness following a workout, & a general sense of well-being. There are different stretching techniques & protocols for improving TA flexibility. Afferent fibers arise from the muscle spindles, synapse on the other alpha or gamma motor neurons & facilitate contraction of the extrafusal & intrafusal fibers.<sup>2,3</sup> GTO is located near the musculotendinous junction and wraps around the ends of extrafusal fibers of a muscle. It is sensitive to the tension in the muscle caused by either passive stretch or active muscle contraction. Pacinian corpuscles located close to the GTO and is responsible for detecting changes in the movements & pressure within the body.<sup>4,5</sup> When

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the muscle is stretched, muscle spindle records the change in length & sends signals to the spine which triggers the stretch reflex which causes muscle contraction. When the muscle contracts, it produces tension at GTO which records the change in tension & rate of change of tension, it exceeds threshold, it triggers the lengthening reaction, which inhibits the muscle from contracting & causes them to relax that is inverse mitotic reflex, autogenic inhibition. When an agonist contracts, in order to cause the desired motion, it usually force the antagonist to relax.<sup>6,7,8</sup> This phenomenon is called as reciprocal inhibition or innervations because the antagonist is inhibited from contraction.<sup>9</sup> There are 5 types of stretching techniques- a) PNF stretching b) cyclic stretching c) dynamic stretching d) self stretching e) static stretching.<sup>10</sup> The second technique is "contract-relax-agonist-contrast" method. There is active contraction of the antagonist, or opposite muscle to get into the stretched position. Reciprocal inhibition refers to relaxation of a muscle in response to activation of its antagonist: in PNF, contraction of opposing muscle is designed to induce reciprocal inhibition within the tight muscle & reduce the resistance to stretch. In hold relax the patient performs the end range before it is passively lengthened by autogenic inhibition, the GTO may fire inhibit the muscle so that it can be easily lengthen.<sup>11,12</sup> In hold relax with agonist contraction technique pre- stretch isometric contraction of tight muscle followed by a concentric contraction of the muscle opposite to tight muscle. In agonist contraction the patients dynamically contracts the muscle opposite the tight muscle against resistance.<sup>13</sup> Hold relax actually involves the use of dynamic or ballistic stretching in conjunction with static & isometric stretches. Cyclic stretching is a form of passive stretching, which is relatively of short duration & the stretch force is applied repeatedly but gradually.<sup>14,15</sup> Multiple stretch cycle are applied in one session. Each cycle lasts for 5-10 seconds. Speed of stretch, whenever slow facilitates the stretch reflex & decrease tension in muscle being stretched: low speed stretch affects the vaso elastic properties of connective tissue , making them more complaint.<sup>15,16</sup> Local relaxation like warming up of soft tissue will increase the extensibility of shortened tissue. Warm muscle relax & tighten more easily as the temperature of muscle increases the amount of force required to elongated non contractile & contractile tissue & time for which stretch force must be applied diseases warm up minimize the chances of minor trauma to the muscle & decreases DOMS.<sup>19</sup> Many cases like wearing high heeled shoes , in this calves

are kept in a state of perceptually shortened length. Resisted plantarflexion is painful with loss of toe push off while walking. Though painful, it is possible for the patient to stand on the toes, raising heel from the ground. Spontaneous relief occurs with local ice application, compression bandage & avoiding over stretching activities along with medication. Functional recovery is seen within the week (7 days). Calf tightness can be symptomatic of weakness elsewhere in the leg, if the gluteus & hamstring are weak, calf will often try to make up for that weakness. This is mainly due to overused calf muscles, which in turn exacerbates calf tightness. In these causes given stretching for 1 week & 1-2 times per day that increases the flexibility of calf muscle<sup>(20)</sup>. There are various studies have been done on TA tightness but there is lack of study which compare the effect of various types of stretching in TA tightness among girls. Therefore the purpose of this study was to compare the effectiveness of Cyclic and PNF stretching in Tendo Achilles tightness among college going girls of Nashik.

## Materials and Methods

A total of 60 college going girls between the age of 18 to 25 years with TA tightness were voluntarily participated in the study. The participants who were having any recent leg and foot injury, metabolic diseases or congenital deformity were excluded from the study. All participants were first filled the written informed consent form. Out of all 60 participants total 40 participants were randomly selected for further participation in this study. All these 40 participants were randomly divided into two equal groups of 20 participants each. Group A consists of 20 participants, were given PNF stretching for 7 days and Group B consists of 20 participants, were given Cyclic stretching for 7 days. The time of exercise and room temperature for the exercise was kept same for all the participants. All the exercises for group A and group B were done at 25°C between 10:00am to 12:00 noon.

## Procedure

Procedure was well explained to all the participants before starting the intervention.

Assessment of all the included participants was done as per the assessment form. Interventions and exercises as per their specific groups were given for 7 days. Post passive ankle dorsiflexion was then measured.

### Intervention

#### Group A (Pnf Stretching)

Participants in the group A were receiving stretching of affected leg, and was performed in sitting.

Patient was asked to sit in a chair upright with straight back and head centered over your shoulders. Loop a towel around the ball of your foot. Straighten your knee and pull the towel tight to target Tendo- Achilles. Patient was asked to hold this for 5 secs followed by voluntary relaxation for 10 secs repeat 10 times.

#### Group B (Cyclicstretching)

Participants in the group B were receiving passive stretching of the Tendo Achilles of their affected leg.

Patient was asked to stand about 3 feet from a wall and put your right foot behind you ensuring your toes are facing forward.

Patients were asked to keep her heel on the ground and lean forward with your right knee straight. Rotating the toes in and out slightly will target the medial and lateral parts of this muscle separately. Hold this for 30 to 60 seconds 10 sets.

### Data analysis

Mean and standard deviation were calculated for descriptive statistics. Students paired t test was used to calculate difference between pre and post values among the group and students unpaired t test was used to calculate difference between both the groups. The statistical analysis was done by SPSS v 16.

### Results

The average age of participants in group A was 21.23 ( $\pm 2.78$ ) and group B was 21.84 ( $\pm 1.93$ ).

The comparison of pre and post treatment in group A is shown in Table 1.

**Table 1:** Comparison of pre and post treatment in group A

Paired T Test	Rom (Dorsiflexion)	
	Pre	Post
Mean	12.15	19
SD	2.084	0.3162
p Value	0.00	
t Value	-17.160	
Significance	Statiscaly Significant	

The comparison of pre and post treatment in group B is shown in Table 2.

**Table 2:** Comparison of pre and post treatment in group B

Paired T Test	Rom (Dorsiflexion)	
	Pre	Post
Mean	12.65	18.65
Sd	1.461	1.137
P Value	0.00	
T Value	-15.916	
Significance	Statiscaly Significant	

The differences in ROM after intervention in both the groups is shown in Table 3.

**Table 3:** The differences in ROM after intervention in both the groups

Unpaired T Test	Mean (Difference)	Sd	p Value	t Value
Group A	6.9	1.714	0.102	1.674
Group B	6	1.686		

As the  $p$  value for group A regarding pre and post treatment ROM was  $<0.0001$ , group A proved extremely statistically significant in improving dorsiflexion ROM in subjects with calf tightness.

As the  $p$  value for group B regarding pre and post treatment ROM was  $<0.0001$ , group B proved extremely statistically significant in improving dorsiflexion ROM in subjects with calf tightness.

ROM comparison between groups showed a  $p$  value of 0.102 which is considered to be not statistically significant. Thus, both the groups are equally effective in improving the dorsiflexion ROM in subjects with calf tightness.

### Discussion

The purpose of the study was to explore the effect of PNF stretching versus CYCLIC stretching on calf tightness in college going girls. In this study, 40 subjects with calf tightness were selected. They were divided into 2 groups, where 20 subjects were in group A (PNF Stretching) and 20 subjects were in group B (CYCLIC stretching) and outcome measure used was active dorsiflexion ROM. From the data analysis of this study, it is found that there is no statistically significant difference between PNF stretching and CYCLIC stretching in improvement of dorsiflexion ROM after 7 days since the ' $p$ ' value between the group was 0.102.

College going girls are more prone to get calf tightness due to prolong standing, sitting, wearing

high heels and lack of physical activity. When they wear heels the gastrocnemius muscle undergo temporary shortening which leads to restriction of ankle dorsiflexion ROM. According to the previous study the results were like that PNF stretching was more effective. Stretching is the general term designed to lengthen pathologically shortened soft tissue stretches and thereby to increase range of motion. Factors responsible neurologically are proprioceptors and golgi tendon organ. Golgi tendon organ is located near the musculoskeletal junction and wraps around the ends of extrafusal fibres of muscles.<sup>23</sup> Pacinian corpuscles located close to GTO are responsible for detecting changes in the movement and pressure within the body. When the muscles was stretched the muscle spindle used to records the change in the length and sends the signals to the spine Stretching of muscle fiber begins with the sarcomere (the basic unit of contraction in muscle fiber).<sup>22</sup> The area of overlap between thick and thin myofilaments increases with the sarcomere contraction. As the muscle stretches, this area of overlap decreases. allowing the muscle fiber to elongate. When the muscle is stretched, the fibers are pulling out to its full length sarcomere and the connective tissues takes up the remaining slack thereafter. This helps to realign any disorganized fibers in the direction of the tension. This realignment is helping in rehabilitating scarred tissue back to health. When we stretch a muscle some fibers get stretched but some remains at rest. The current length of the muscle depends upon the number of stretched fibers.<sup>15</sup> PNF stretching is an advanced method of stretch training used to increase flexibility. It intersperses static stretching with series of muscle contractions or isometric activations. The goal was to improve dorsiflexion ROM. The method used was HOLD RELAX technique. During PNF stretch and isometric contraction of stretched agonist for extended period may cause activation of its neuromuscular spindle.<sup>10</sup> The increase in tension created during the isometric contraction of the pre lengthened agonist contract concentrically. These impulses travelled after causing post synaptic inhibition of the motor neuron to agonist which increases the tension from the GTO. These impulses may override the impulses which are coming from the neuromuscular spindles thus arousing the muscle to reflex resist to the change in length, and helping in lengthening the muscle.<sup>25</sup> The nerve ending that relay all the information of musculoskeletal system to central nervous system are called as proprioceptors. The proprioceptors are detecting and changing in physical displacement

(movement or position) as well as in any changes in tension or force within the body. Reason of holding a stretch for prolonged period of time is that by holding the muscle in stretched position, the muscle spindle becomes accustomed to the new length and reduces its signalling. Gradually we can train the stretch receptors to allow greater lengthening of muscle.<sup>21</sup> Muscle spindle are small encapsulated receptors composed of afferent sensory fiber endings, efferent motor fiber endings and specialized muscle fibers called intrafusal fibers and extrafusal fibers are bundled together and lie between parallel to the extrafusal fiber that make up main body of skeletal muscle. Cyclic stretching is a type of passive stretching, which is relatively of short duration and the stretch force is applied repeatedly and gradually. The multiple repetitions of stretch cycles are applied in 1 session speed of stretch affects the viscoelastic properties of connective tissue, making them more compliant. Local relaxation like warming up of soft tissue will increase the extensibility of shortened tissue.<sup>24</sup>

Warm muscle relaxes and tightens more easily because the temperature of muscle increases the amount of force required to elongate the non contractile and contractile tissue and time for which stretch force must be applied decreases warm up minimize the chance of minor trauma to the muscle and decreases domes.<sup>26</sup>

## Conclusion

The finding of the present study suggested that both the techniques showed significant improvement in improving the dorsiflexion ranges with TA tightness in college girls of Nashik.

Both the PNF and Cyclic stretching techniques are effective in improving TA flexibility and improving ankle range of motion, but PNF is more effective, but not statistically, compared to cyclic stretching in reducing TA tightness.

*Conflict of Interest:* No conflicts of interest

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