



TO STUDY IMMEDIATE EFFECT OF SURYANAMASKAR VERSUS NEURODYNAMIC SLIDING TECHNIQUE ON HAMSTRING FLEXIBILITY AMONG PHYSIOTHERAPY STUDENTS

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Abstract

Background

Suryanamaskar is a popular traditional Indian yoga practice also called 'Sun Salutation'. It includes practice of twelve physical postures which involve alternative backward bending and forward bending poses. During Suryanamaskar, muscles of the entire body experience stretch and pressure alternately and therefore it is said to give more benefits with less expenditure of time. Neurodynamics is the term used to describe the integration of the morphology, biomechanics and physiology of the nervous system. Abnormal posterior lower extremity neurodynamics may influence resting muscle length and lead to changes in the perception of stretch or pain. Neurodynamic sliding technique (NDT) and Suryanamaskar both have been individually advocated for increasing hamstring flexibility but comparison of these techniques have not been found in studies. So the purpose of the study was to compare the effects of these techniques on hamstring flexibility among physiotherapy students in the dominant leg.

Aim

The aim of the study was to compare the immediate effects of ancient yoga practice in the form of suryanamaskar and application of movement/stress to nervous system in the form of neurodynamic sliding technique to improve hamstring flexibility in physiotherapy students.

Methods

In this study, 48 physiotherapy students according to the inclusion and exclusion criteria were recruited from M.V.P'S College Of Physiotherapy. Their ages ranged from 18-25 years. The subjects were tested for their dominant leg. The subjects underwent Suryanamaskar and Neurodynamic sliding technique for one minute with a rest period of 30 secs respectively. The same procedure was repeated 5 times. Popliteal angle was used to measure hamstring flexibility among physiotherapy students. The pre and post test data was collected.

Result

The study showed that there is an effect of Suryanamaskar and Neurodynamic sliding technique in improving hamstring flexibility among physiotherapy students as the P value regarding pre and post treatment of Popliteal angle was <0.0001 . When mean difference of popliteal angle was compared between the suryanamaskar and NDT group the values were 13.46 and 15.42 respectively with p value being <0.005 which suggests that both are equally effective in improving hamstring tightness.

Conclusion

The conclusion of study is that Neurodynamic sliding technique and Suryanamaskar are equally effective in improving hamstring flexibility in the dominant leg among physiotherapy students.

INTRODUCTION

Hamstring is a two joint muscle which contracts eccentrically to maintain a proper posture in standing hence are prone to be tight. Physiotherapists are looked upon as role models for practicing a healthy lifestyle. They require a good amount of flexibility and endurance to meet the professional demands. Improved hamstring flexibility plays an important part in the physical fitness levels of physiotherapists. Physiotherapists play an important role in healthcare system hence they need to have a good level of physical fitness to meet their job demands. Hence this awareness needs to be created right from the student level. According to a study done in Punjab in 2013 which assessed the level of fitness among physiotherapy students, the physical fitness level of the physiotherapy student is not satisfactory as compared to the physical demands of the profession. Hence this study emphasizes the hamstring flexibility of physiotherapy students by comparing the effectiveness of Suryanamaskar and neurodynamic sliding technique.^[1]

Suryanamaskar or salutation to the sun is an ancient method of yogic practice in India.^[1] It is a series of 12 physical postures made up of a variety of forward and backward bends which are- **Pranamasan, hasta uthasan, padahastasan, ashwa sanchalasan, parvatasan, ashtanga namaskar, bhujangasan.**^[1] Suryanamaskar causes stretching and contraction of the muscles in a systematic manner leading to increased flexibility and strength of muscles.^[1] The series of movement stimulates blood circulation to the entire spinal column and brain resulting in a healthy nervous system. Suryanamaskar causes stretching and contraction of the muscles in a systematic manner leading to increased flexibility and strength of muscles.^[1] Surya Namaskar is a series of asanas with strict breathing pattern. Suryanamaskar energizes every cell in the body leading to increased strength, flexibility and leads to calmness of mind. These postures (asanas) encompass periodic forward and backward bending along with deep exhalation and inhalation respectively to the maximum possible extent.^[3] By these movements, the whole musculoskeletal system is stretched and contracted in a systematic manner which provides more strength and flexibility to them. Its training improves the flexibility of body muscles especially leg, back, chest and buttock muscles.^[3] Surya Namaskar significantly decreases in fasting blood sugar, postprandial blood sugar and Glycosylated haemoglobin HbA1c level in diabetic patients. The Autonomic nervous system generally involved in diabetic patients but by practicing Surya Namaskar, a positive impact also noted on autonomic function of the body. Its regular practice of significantly decreases the oxidative stress of the body which plays a key role in insulin resistance and complication in diabetes patients. This results in the reduction of weight, BMI and waist-hip ratio.^[4]

Flexibility refers to the anatomical range of movement in a joint or a series of joint, and length of muscles that cross the joint to induce a bending movement or motion. The hamstring muscles have a tendency to go in tightness. Inability to extend the knee completely when the hip is flexed associated with pain along the posterior thigh is usually attributed to hamstring muscle tightness and this is found in asymptomatic normal individuals. Low back muscles and hamstring flexibility is needed for doing everyday tasks such as bending over and sitting.^[5]

Neurodynamics is the term used to describe the integration of the morphology, biomechanics and physiology of the nervous system.^[5] Abnormal posterior lower extremity neurodynamics may influence resting muscle length and lead to changes in the perception of stretch or pain.^[5] An individual with decreased hamstring extensibility may demonstrate limited range in the passive straight leg raise test (SLR) because of altered neurodynamics affecting the sciatic, tibial and common fibular nerves. Abnormal posterior lower extremity neurodynamics may influence resting muscle length and lead to changes in the perception of stretch or pain. It follows that providing a movement/stretching intervention could alter the neurodynamics and lead to modification of the sensation and ultimately, increased extensibility.^[5] It is observed from studies that individual's perception of stretch and pain as well as mechanical properties of muscle being stretched are responsible for tissue extensibility. This is known as the 'sensory theory' and it proposes that increases in muscle extensibility after stretching are due to modified sensation. A better way of treating perceived hamstring tightness is by targeting the neural mobility or neurodynamic system. Direct nerve mobilization consists of sliders, tensioners and single joint nerve mobilization, addressing the mechanical interface, postural correction and ergonomic adaptations are ways of approaching altered neurodynamics.^[5] So use of neurodynamic sliding technique can be useful to alter such sensation and ultimately can improve hamstring flexibility.^[5] In these exercises tension is increased at one end and lessened at the opposite end of the nerve, thus improving nerve excursion.^[5] There is indeed ample evidence that elongation of the nerve bed induces nerve gliding (Szabo et al., 1994; Byl et al., 2002; Dilley et al., 2003; Coppieters et al., 2006). Stretching of the nerve bed increases nerve tension and intraneural pressure which in turn elongates the nerve. Whereas sustained elevated intraneural fluid pressure reduces intraneural blood flow in oedematous neuropathies (Myers et al., 1986), a dynamic variation in intraneural pressure when correctly applied may facilitate evacuation of oedema from intraneural spaces which in turn reduces symptoms (Burke et al., 2003). In contrast, the increase in nerve strain associated with elongation of the nerve bed may also trigger ectopic discharges from mechanosensitive abnormal impulse generating sites (Dilley et al., 2005) and exacerbate symptoms.^[6] Neurodynamics is a manual method of applying force to nerve structures through posture and multi-joint movement. Based on the principle that the nervous system should be also stretched and contracted properly to maintain normal muscle tension and ensure range of motion, this technique is used for the recovery of soft tissue mobility. Movement of the body both increases the strain on nerves and moves nerves associated with the surrounding tissue.^[7] Some studies report that neurodynamics is effective for improving pain, flexibility, and muscle strength, but only a few studies assessed the effect of neurodynamics on balance. Thus, this study was designed to elucidate the effects of a neurodynamic sciatic nerve sliding technique on hamstring flexibility and postural balance.^[7]

Thus the purpose of the study was to find out the immediate effectiveness of Suryanamaskar versus neurodynamic sliding technique on hamstring flexibility in the dominant leg among physiotherapy students.

PURPOSE OF STUDY

The purpose of the study was to find out the immediate effectiveness of Suryanamaskar versus neurodynamic sliding technique on hamstring flexibility in the dominant leg among physiotherapy students.

AIM OF THE STUDY

The aim of the study was to compare the immediate effects of ancient yoga practice in the form of suryanamaskar and application of movement/stress to nervous system in the form of neurodynamic sliding technique to improve hamstring flexibility in physiotherapy students.

OBJECTIVES OF THE STUDY

1. To study the immediate effectiveness of suryanamaskar on hamstring flexibility among physiotherapy students.
2. To study the immediate effectiveness of neurodynamic sliding technique on hamstring flexibility among physiotherapy students.
3. To compare the immediate effectiveness of suryanamaskar and neurodynamic sliding technique on hamstring flexibility among physiotherapy students.

HYPOTHESIS

Neurodynamic sliding technique is more effective than Suryanamaskar on hamstring flexibility among physiotherapy students.

ALTERNATE HYPOTHESIS

Suryanamaskar is more effective than Neurodynamic sliding technique on hamstring flexibility among physiotherapy students.

NULL HYPOTHESIS

Neurodynamic sliding technique and Suryanamaskar both are equally effective in improving hamstring flexibility among physiotherapy students.

RESEARCH METHODOLOGY

- **STUDY TYPE:** Comparative.
- **SAMPLING METHOD:** Convenient.
- **SAMPLE SIZE:** 48
- **STUDY SETTING:** MVP'S COLLEGE OF PHYSIOTHERAPY AND HOSPITAL, NASHIK.
- **DURATION OF STUDY:** 6 MONTHS.

INCLUSION CRITERIA:

1. Age: 18-25 Years.^[1]
2. Male & Female.^[1]
3. Active knee extension range 20-40 degree.^[1]
4. Hamstring tightness.^[3]

EXCLUSION CRITERIA:

1. Low back pain.^[5]
2. History of hamstring injury in past years. ^[5]
3. History of neurological disease or peripheral neuropathy. ^[5]
4. History of orthopedic disorder affecting lower limb (e.g. femoral fracture, meniscal injury etc.) ^[5]
5. Cardiovascular disorders. ^[5]

MATERIALS TO BE USED:

1. Universal Goniometer.
2. Paper.
3. Pen.
4. Consent form.
5. Yoga Mat.
6. Couch.

OUTCOME MEASURES:

Popliteal Angle (pre and post values).^[3]

1. Fulcrum: lateral epicondyle of femur.
2. Moving arm: Pointing towards the lateral malleolus.
3. Stable arm: pointing towards greater trochanter.



Fig 01-Measuring Popliteal Angle

PROCEDURE

- Subjects were screened according to inclusion and exclusion criteria. Ethical clearance was obtained and informed consent was taken from each subject. Subjects were briefed about the study & the intervention.
- All the subjects were measured for hamstrings flexibility using the popliteal angle.
- They were demonstrated the techniques prior to the measurement and after recording the pre measurements the subjects were made to do 5 slow Suryanamaskar with 10 sec hold at each asana.

ONE LEG STAND PROCEDURE:^[12]

- Then subjects were instructed to stand with one limb with other limb raise so that raised foot is near but not touching the ankle of their stance limb. Each subject was asked to stand with arms crossed and focusing on a point directly in front of them and then raise one limb while balancing on the other limb. The time for which the subject was able to hold the position was recorded using a stopwatch.
- Timer was started when the subjects raised the foot off the floor, time ended when the subject either
- Used his arms (uncrossed arm)
- Faltering of the weight bearing limb to maintain balance
- The subject maintained the one leg stand position for more than 45 seconds. After each one leg stand test the subject was given a rest period of 1 minute to avoid fatigue



Fig 02- ONE LEG STAND

Prior to the particular technique the patient were made to perform warm up exercises for 5 minutes and at the end of the procedure the patient was made to perform cool down exercises for 3 minutes.^[11]

GROUP A

Surya Namaskar postures: It consists of a total of 12 postures/asanas:

1. Pranamasana (Prayer Pose) The subject stood erect with palms held close to the chest in prayer pose. She was instructed to only inhale, without making any other movement of the body.



Fig 03- Pranamasana (Prayer Pose)

2. Hastauttanasana (Raised Arm Pose) The subject raised both arms overhead, tilting the head, neck and upper body gently backward while gazing up at the thumbs. She was asked to exhale the breath completely.



Fig 04- Hasta Uttanasana (Raised arms pose)

3. Hasta Padasana (Hand to Foot Pose) Inhaling, the subject started bending forward in the waist and placed the palms on the floor in the line of the toes, without bending the legs in the knees.



Fig 05- Padahasthasana (Hand to Foot pose)

4. AshwaSanchalanasana (Equestrian Pose) The subject then exhaled completely and took one leg behind, resting its knee on the floor. She pressed the waist downwards and raised the neck upwards.



Fig 06- Ashwa Sanchalanasana (The Equestrian Pose)

5. Dandasana (Stick Pose) The subject was then asked to inhale and raise the knee off the floor. Taking the other leg behind, she then straightened both the legs and the arms. The neck, spine, thighs and feet were kept in a straight slant line.



Fig 07- Dandasana (Stick Pose)

6. AshtangaNamaskara (Salute with Eight Parts) Exhaling, she bent both the arms in the elbows. The forehead, chest, both the palms, both the knees and toes touched the floor. The hips were raised off the floor.



Fig 08- Ashtanga Namaskara (Eight-Limbed)

7. Bhujangasana (Cobra Pose) The subject inhaled and straightened the elbows, stretching the shoulders upwards. The toes and knees rested on the floor. Keeping the arms straight, she raised the chest off the floor and curved her back.



Fig 09- Bhujangasana (The Cobra Pose)

8. Parvatasana (Mountain Pose) Exhaling she altogether bent the neck downward and pushed the body backwards and up. The positions of the toes and palms on the floor was not changed.



Fig 10- Parvatasana (The Mountain Pose)

9. AshwaSanchalasana (Equestrian Pose) The subject inhaled and brought one leg to the front and placed it between the palms of the two arms like position 4.



Fig 11- Ashwa Sanchalasana (Equestrian Pose)

10. Hasta Padasana (Hand to Foot pose) Exhaling she started bending forward in the waist, placing the palms on the floor in the line of the toes, without bending the legs in the knees just like position 3.



Fig12- Hasta Padasana (Hand to Foot pose)

11. Hastauttanasana (Raised Arms Pose) While inhaling she raised both arms off the floor and overhead while tilting the head, neck and upper body backward just like position 2.



Fig 13- Hastauttanasana (Raised Arms Pose)

12. Pranamasana (Prayer Pose) Exhaling she brought the hands down and forward and straightened her back, taking the initial position.



Fig 14- Pranamasana (Prayer Pose)

After performing 5 rounds of Surya Namaskar the participants were given 1 minute rest. The post measurements of popliteal angle values were recorded. ^[3]

GROUP B

In this group subjects were treated with neurodynamic sliding technique. ^[5]

The neurodynamic sliding technique consists of 'seated straight leg slider'. ^[5]

Neurodynamic Sliding Technique causes sliding movement of neural tissue relative to their adjacent structures.. 6-10 Sliders involve application of movement/stress to the nervous system proximally while releasing movement/stress distally, and then reversing the sequence. ^[5]

Subject sit with their trunk in thoracic flexion (slump) posture, they perform alternating movements of knee extension/ankle dorsiflexion with cervical extension, and knee flexion/ankle plantar flexion with cervical flexion. ^[5]

Subjects perform these active movements for approximately 60 seconds and repeat them for 5 times. ^[5]



FLEXION

EXTENSION

Fig 15-Neuro dynamic sliding technique

DATA ANALYSIS

GROUP 1: SURYANAMASKAR

TEST- Paired t-test (Within the Group)

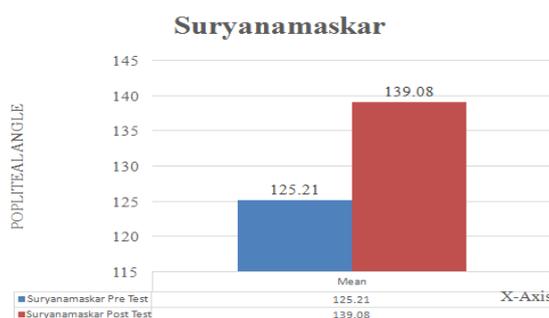
TABLE 1: COMPARISON OF PRE AND POST VALUES OF SURYANAMASKAR USING PAIRED t TEST

Suryanamaskar

SURYANAMASKAR	PRE TEST	POST TEST
Mean	125.21	139.08
SD	4.75	8.32
SEM	0.97	1.70
N	24	24

P value- <0.0001
 t-9.8526
 df-23
 Standard error of difference-1.366

GRAPH 1:COMPARISON OF PRE AND POST MEAN TREATMENT-VALUES OF SURYANAMASKAR USING PAIRED t TEST



DATA INTERPRETATION: The mean value of popliteal angle within suryanamaskar group was 125.21 before the treatment and after the treatment the mean was 139.08 and P- value is < 0.0001 and the result is extremely statistically significant.

GROUP 2- Neurodynamic Sliding Technique(Within the Group)
 TEST- Paired t-test

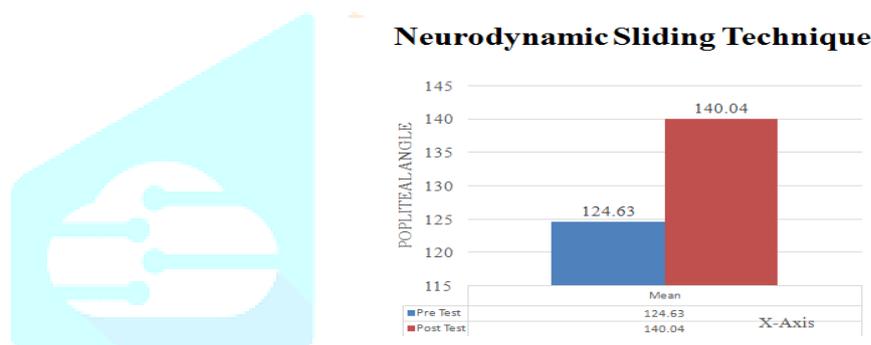
TABLE 2:COMPARISON OF PRE AND POST VALUES OF NEURO DYNAMIC SLIDING TECHNIQUEUSING PAIRED t TEST.

Neurodynamic Sliding Technique	PRE TEST	POST TEST
Mean	124.63	140.04
SD	5.87	8.05
SEM	1.20	1.64
N	24	24

P value- <0.0001

t -11.1896

df-23

GRAPH 2:COMPARISON OF PRE AND POST MEAN TREATMENT VALUES OF NEURO DYNAMIC SLIDING TECHNIQUE USING PAIRED t TEST

DATA INTERPRETATION: The mean value of popliteal angle within neuro dynamic sliding technique group was 124.63 before the treatment and after the treatment the mean was 140.04 and P- value is < 0.0001 and the result is extremely statistically significant.

COMPARISON BETWEEN GROUPS A AND B:

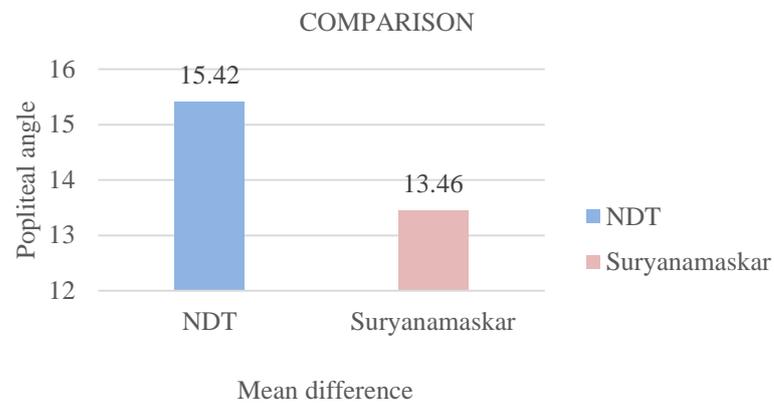
TEST- Unpaired t-test (between the group)

TABLE 3:COMPARISON OF POST TREATMENT SCORES OF MEANDIFFERENCEUSING UNPAIRED t TEST.

GROUP	Suryanamaskar	Neurodynamic Sliding Technique
MEAN DIFFERENCE	13.46	15.42
SD	6.9	6.75
SEM	1.26	1.38
N	24	24

- P value-0.3002
- t-1.0479
- df-46
- Standard error of difference-1.869

GRAPH 3:COMPARISON OF POST VALUES OF MEANDIFFERENCE VALUES OF SURYANAMASKAR ANDNEURO DYNAMIC SLIDING TECHNIQUE USING UNPAIRED t TEST



DATA INTERPRETATION: The mean difference value of popliteal angle between neuro dynamic sliding technique and suryanamaskar group was 15.42 and 13.16 after the treatment the and P- value is 0.3002 and the result is statistically non-significant.

DISCUSSION

Statistical analysis proves that both Suryanamaskar and Neurodynamic Sliding Technique are effective in improving hamstring flexibility for dominant leg with p-value <0.0001. This study also proves that both Suryanamaskar and Neurodynamic Sliding Technique are extremely statistically significant, hence, this study accepts the null hypothesis. However there is significant difference in improvement within the group.^[1]

Hamstrings form a part of the superficial back line. The superficial back line connects and protects the entire posterior surface of the body from the bottom of the foot to the top of the head. When the knees are extended, as in standing, the SBL works as a continuous line of integrated myofascial. Hence the hamstrings get stretched through the superficial back line when suryanamaskar is performed.^[1]

In Suryanamaskar the superficial line also gets stretched which co-contraction of the superficial back line. Owing to the contraction of the muscles of the back even the smallest muscles of the spinal column, as well as the muscles of the back are strengthened. Suryanamaskar improves blood circulation in the vertebral region, and consequently, the nerves in the region are invigorated. Along with the hamstrings, the flexibility of the spine is increased and maintained in Suryanamaskar.^[1]

In addition to flexibility, Suryanamaskar has been proved to have positive physiological effects by improving pulmonary function, respiratory pressures, hand grip strength, endurance and resting cardiovascular parameters.^[1]

A similar study was performed by Kanwaljeet Singh, Dr. Baljinder Singh Bal, Dr. Winfred Waz, on the effects of Suryanamaskar on muscular endurance and flexibility among intercollege yoginis. It proves that Suryanamaskar yoga has a significant effect on improving muscular endurance and hamstring flexibility.^[2]

The increase in flexibility can most likely be attributed to the static stretching nature of the asanas. The probable reason may be that suryanamaskar is the combination of twelve exercises that include stretching, holding and relaxation. Stretching is most commonly advised as a method for increasing flexibility. The increased range of motion resulting from prolonged stretching is most likely due to an increase in length of both connective and muscle tissue. Increased connective tissue length can occur due to its property of elastic elongation.^[3]

Suryanamaskar improves metabolic function, strengthens and flexible musculoskeletal system, balances endocrinal system, tunes central nervous system, supports urogenital system and boosts gastrointestinal system.^[4]

In NDST group, who received Neurodynamic Sliding Technique, showed that there is statistically significant change in means of passive SLR ROM when means were analyzed from pre intervention to post intervention within the group with positive percentage of change showing there is increase in post means. This could be due to Neurodynamic Sliding Technique, when tension is applied to a nervous system while applying neurodynamics it causes reduction in cross-sectional area and increase in pressure in the nerve that results in extension and movement of the sciatic nerve together while the hamstring and the compliance of this nerve, results in increased flexibility. When applying neurodynamics, tension that occurs in the nervous system and pressure within the nerve increases due to decrease in cross-sectional area, and the axonal transport system lengthens the sciatic nerve after shortening because of the influence of the surrounding related structures and hamstring flexibility.^[5]

The observed changes may have been secondary to decreasing neuromeningeal sensitivity or may be that the neurodynamic sliders led to a modification of sensation such that the individual's perceptions of stretch or pain were altered.^[5]

Longitudinal excursion and strain associated with a particular joint movement is strongly influenced by the position or simultaneous movement of an adjacent joint. This study demonstrated that movements which increased and decreased the length of the nerve end are performed simultaneously at adjacent joints, nerve gliding occurs with almost no increase in nerve strain. Facilitation of nerve gliding in this manner (sliding technique) is markedly different to inducing nerve gliding by elongating the nerve end and increasing nerve strain (tensioning technique or isolated joint movement)^[6]

When applying neurodynamics, tension occurs in the nervous system, and pressure within the nerve increases due to the decrease of the cross sectional area, and the axonal transport system lengthens the sciatic nerve after shortening because of the influence of the surrounding related structures and hamstring flexibility. After extension of the nerve and muscle, performance is improved because of increase in the number of muscle fiber segments and cross sectional area of muscle fibers^[7]

Most of the existing research has focused on different modes of stretching such as proprioceptive neuromuscular facilitation, static stretching, plyometric stretching and ballistic stretching^[8]

Physiotherapy is a profession which requires physical activity and adequate level of physical fitness. The fitness levels required by the physiotherapy professionals are high due to professional demands and also because physiotherapy professionals are projected as fitness experts in the society. The students perceive their fitness to be of the normal level, whereas, the measured fitness shows different results. The measured level of fitness is lower as compared to the perceived levels. Also, the presence of musculoskeletal pain in physiotherapy students is alarming. These findings indicate towards the need of developing a fitness culture among the students^[9]

According to clinical observation neurodynamic sliding technique was more effective as compared to suryanamaskar since the sliding technique was performed only on the dominant leg as compared to suryanamaskar which involved stretching of bilateral lower limbs.

CONCLUSION

The conclusion of study is that neurodynamic sliding technique and suryanamaskar are equally effective in improving hamstring flexibility in the dominant leg among physiotherapy students.

SUGGESTIONS

Long term follow up of the subjects is recommended in further studies to see the long term effects of the protocol. The study can be done in different conditions.

Conflict of Interest: None

Ethical Adherence: Yes

Disclaimers: None

Source of Funding: self

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