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Effect of core stability exercises versus Surya Namaskar on hamstring tightness in healthy adults using active knee extension test at the end of 6 weeks: A comparative study

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Abstract

Hamstring tightness is commonly linked with movement dysfunction at the lumbar spine, pelvis and lower limbs and have been coupled with low back pain and gait abnormalities. The prevalence of hamstring tightness is high in college students due to the sedentary lifestyle. The weak gluteals result in increased activity of hamstrings and erector spinae as compensation to assist hip extension. Core stability exercises helps in activation of gluteus maximus muscle, indirectly causing lengthening in hamstring muscle but through pelvic motion. Surya Namaskar helps to stretch the hamstring muscle which leads to increase in the number of sarcomeres and thus reduces tightness and increases flexibility. The purpose of this study was to compare the effects of core stabilization exercise and Surya Namaskar on hamstring tightness.

Method: A sample of 60 individuals were taken as per the inclusion criteria and were divided into two groups. The subjects in Group A (n=30) were made to do supine bridging, single leg hamstring bridge and single leg deadlift and Surya Namaskar in Group B (n=30) for 6 weeks (3 days/week). Progression was done every week. Active knee extension test was used pre and post treatment to measure hamstring tightness.

Result: The findings of this study revealed a significant improvement of hamstring tightness in both the groups post-intervention. When the mean difference of both the groups were compared, group A showed more significant result than group B (for right leg $t=3.186$, $p=0.02$; for left leg $t=3.712$, $p<0.001$).

Conclusion: Core stabilization exercises show greater result than Surya Namaskar statistically.

Keywords: Hamstring tightness, surya namaskar, core stability exercises, active knee extension test

1. Introduction

Hamstring is the common muscle which undergoes adaptive shortening when compared with other groups of muscles. Hamstrings refer to the three posterior thigh muscles, the semitendinosus, the semimembranosus and the biceps femoris and its action includes hip extension and knee flexion. The hamstring muscles are commonly linked with movement dysfunction at the lumbar spine, pelvis and lower limbs and have been coupled with low back pain and gait abnormality^[1]. Hamstring tightness is associated with a posterior rotation of the pelvis in standing due to the attachment of hamstring muscle on the ischial tuberosity. Tightness in hamstring causes posterior pelvic tilt which leads to decrease in lumbar lordosis resulting in low back pain^[2].

In a study conducted, the prevalence of hamstring tightness was concluded to be 82% & prevalence of hamstring tightness was more in females than in males^[3].

The core can be described as a muscular box with the abdominals in the front, paraspinals and gluteal muscles in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom^[4].

Core stability exercise programs target these muscles to help improve the overall function of the spine and body during activities of daily living, where it provides 'proximal stability for distal mobility'^[5].

The weak gluteals result in increased activity in the hamstrings and erector spinae as compensation to assist hip extension. The hamstrings show tightness as they attempt to pull

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the pelvis backward to compensate for anterior rotation caused by tight hip flexors [6].

Surya Namaskar

In Indian culture, yoga has traditionally been a part of daily routine which is meant for attaining healthy life.

Sun salutation, also called as Surya Namaskar, sun adoration for health, efficiency and longevity is a part of Indian traditional yogic practices. It involves pranayam, asana and upasana i.e. rituals. The sun salutation is performed as a cyclical event synchronized with a specific breathing pattern. Each cycle consists of 11 steps performed consecutively one after the other.

Regular training of Surya Namaskar required four times more energy than the daily requirement, Thus it is a very good fat burner. It's training improves the flexibility of body muscles especially leg, back, chest and buttock muscles [7].

It is found that by practicing Surya Namaskar regularly can significantly increase Hand grip, strength and endurance [8].

There are a number of changes that occur over time in the anatomical structure and physiological function of the contractile units (sarcomeres) in muscle if a muscle is stretched during an exercise. Surya Namaskar helps to stretch the muscle, which leads to increase in the number of sarcomeres and thus reduces tightness and increases flexibility [9].

2. Need of the study

Prevalence of hamstring tightness in college students is high due to sedentary lifestyle. It is higher in females than in males. Hamstring tightness can lead to increased risk of low back pain, muscle strain, plantar fasciitis etc. Studies have been done on core stability exercises to decrease low back pain but very few studies have been done to see the effect on hamstring tightness. Also, the effect of Surya Namaskar on flexibility and endurance of the muscles have been seen in few previous studies. But no study have been done to compare the effect of core stability exercises and Surya Namaskar on hamstring tightness in college students.

3. AIM

To study the effect of Core stability exercises versus Surya Namaskar on hamstring tightness at the end of 6 weeks

4. Objectives

1. To study the effectiveness of core stability exercises on hamstring tightness at the end of 6 weeks
2. To study the effectiveness of Surya Namaskar on hamstring tightness at the end of 6 weeks
3. To compare the effects of core stability exercises and Surya Namaskar on hamstring tightness at the end of 6 weeks

5. Hypothesis

Null hypothesis: There will be no difference in effect of core stability exercise and Surya Namaskar on hamstring tightness at the end of 6 weeks.

Alternate hypothesis

(H1): Effect of Surya Namaskar will be better than core stability exercises on hamstring tightness at the end of 6 weeks.

(H2): Effect of core stability exercises will be better than Surya Namaskar on hamstring tightness at the end of 6 weeks.

6. Methodology

Sample size	60
Study design	Comparative study
Sampling method	Convenience sampling
Study population	Adults between 18-25 years of age
Study setting	In and around hospitals of Pune
Study duration	6 months
Treatment duration	6 weeks

Inclusion criteria

Both male and female students, age 18-25 years, Grade 3 and 4 on isometric abdominal test and isometric extensor test, Grade 3 and 4 for gluteus maximus on manual muscle testing, Subjects with more than 20 degrees loss of knee extension on active knee extension test.

Exclusion criteria

Any past hamstring injury within last 2 years, Low back pain past 2 months, Sciatica, Recent spine or extremity fracture (within 6 months), Ankylosing spondylitis.

7. Materials and Tools

1. Measuring tape
2. Pen
3. Plinth
4. Yoga mat
5. Goniometer
6. PVC frame

8. Outcome Measures

Active Knee Extension Test

Subjects was assessed on a plinth in the supine position with both lower extremities extended. Both anterior superior iliac spines were positioned by aligning them. The lower extremity not being measured was secured to the plinth using a strap across the lower third of the thigh. The assessor marked the lateral knee joint line with washable ink. From there, two lines were drawn. The first, drawn to the greater trochanter, and another drawn to the apex of the lateral malleolus. The subjects were told to flex the hip until the thigh touched the horizontal bar. While maintaining the contact between the thigh and bar, the subjects were asked to extend the leg as much as possible while keeping their foot relaxed and to hold the position for about 5 seconds. A standard universal goniometer was placed over the previously marked joint axis, and the goniometer arms were aligned along the femur and fibula. Measure the minimum angle of knee flexion with the thigh in vertical position. If the leg can be fully extended it can be stated as 0 degrees [10]. The readings were taken thrice and an average of the three was considered.

9. Procedure

The study began with the presentation of synopsis to an ethical committee. Further proceedings were done after the approval from the ethical committee in PES Modern College of Physiotherapy, Shivajinagar Pune-5. Study was conducted in and around Pune. Subjects were selected according to the inclusion and exclusion criteria based on and divided into two equal groups by odd even method. The subject were explained about the study in detail. Consent was taken from the patients who are eligible according to the inclusion criteria and wish to participate in the study. Subjects were assured that the collected data will not be

misused in any form. Prior to the intervention, outcome measures for hamstring tightness by active knee extension test was taken. At the end of sixth week of intervention outcome measures were taken again.

Group A: Received core stability exercises for 6 weeks.

Group B: Received Surya Namaskar for 6 weeks.

Group A

Core Stability Program

1. Drawing in Maneuver

The patient assumes a neutral spine position and while maintaining it the abdominal muscles was drawn in gently. Once activated, the contraction should be maintained and breathing should be resumed normally. Performing this maneuver with spine in neutral position results in increased TrA activation.

2. Supine Bridging Exercise

This was performed in supine position with hand beside the body. Instructions were given to perform drawing in maneuver of the abdomen and gently lift up the buttock. Hold the position for 5secs, repeat 5 times Progression was done by increasing the time of hold and repetitions.

3. Single Leg Hamstring Bridge

Start with supine bridging exercise and extend one knee

keeping the trunk in a straight line hold for 5secs repeat 5 times. Progression was done by increasing the range, the hold time and the repetitions.

4. Single limb deadlift

In unilateral stance with weight bearing hip and knee in 30° flexion. Have the patient bend forward at the hips and reach for toes of the stance leg with the contralateral hand while extending hip and knee of the non-weight bearing leg behind, then return to upright starting position. Hold for 5 seconds and repeat 5 times. Progress by increasing hold time and repetitions.

Group B

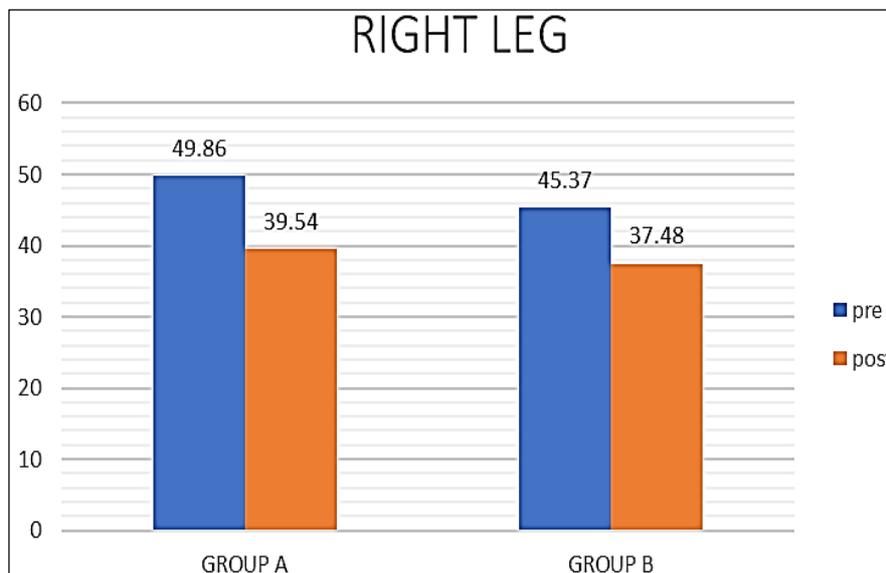
Performed all 12 stages of Surya Namaskar with 10 seconds hold for each pose. Initially with 2 sets and progressing by increasing the number of sets each week.

10. Statistical Analysis

Hamstring tightness was assessed post intervention using active knee extension test. The data was entered in excel spreadsheet tabulated and subjected to statistical analysis. The data collected passed the normality test. Pre and post values of both the groups were compared using paired t test using Primer for Biostatistics (Version 7).

Table 1: Show effectiveness of Core stability exercises and Surya Namaskar on right hamstring muscle tightness

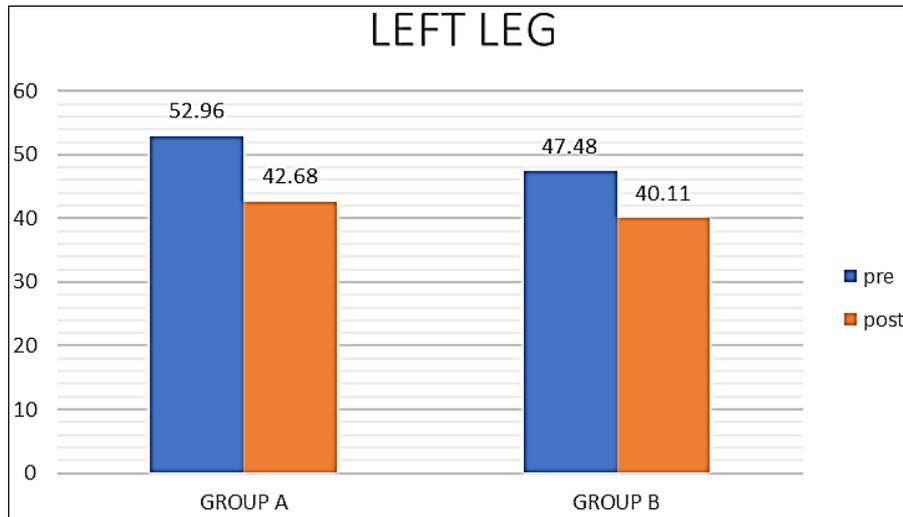
Group		Mean ± SD	t value	p value	Significance
Group A	Pre Value	49.86±8.5	15.039	<0.001	significant
	Post Value	39.54±7.5			
Group B	Pre Value	45.37±8.5	18.147	<0.001	significant
	post value	37.48±8			



Graph 1: Show effectiveness of Core stability exercises and Surya Namaskar on right hamstring muscle tightness

Table 2: Shows effectiveness of core stability exercises and Surya Namaskar on left hamstring muscle tightness

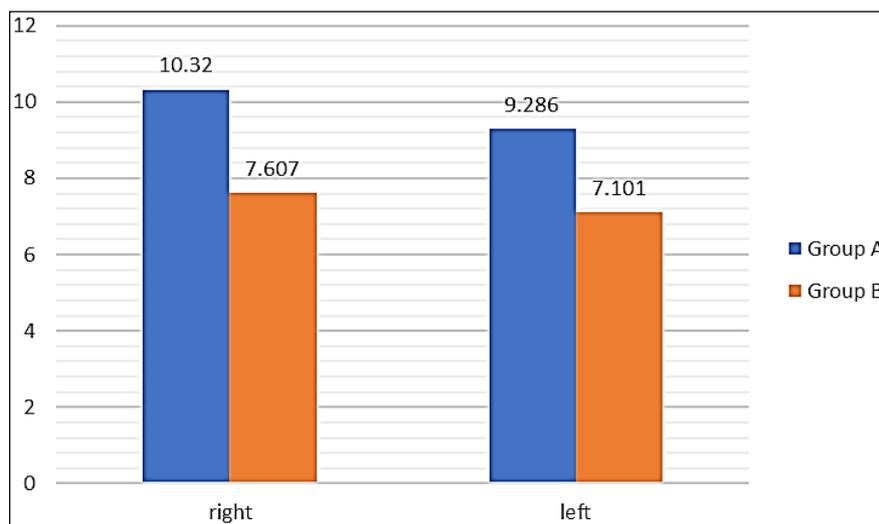
Group		Mean±SD	t value	p value	Significance
Group A	Pre Value	52.96±7.724	21.60	<0.001	significant
	Post Value	43.68±7.841			
Group B	Pre Value	47.48±8.121	23.63	<0.001	significant
	Post Value	40.11±7.772			



Graph 2: Shows effectiveness of core stability exercises and Surya Namaskar on left hamstring muscle tightness

Table 3: Shows the difference between the effectiveness of core stability exercises and Surya Namaskar on hamstring tightness

		Mean±SD	t value	p value	significance
Right	Group A	10.32±3.632	3.186	0.002	significant
	Group B	7.607±2.671			
Left	Group A	9.286±2.275	3.712	<0.001	Highly significant
	Group B	7.107±2.114			



Graph 3: Shows the difference between the effectiveness of core stability exercises and Surya Namaskar on hamstring tightness

11. Result

- The mean values of active knee extension test for Group A pretreatment and post treatment showed significant difference when compared (for right leg $t=15.039, p<0.001$; for left leg $t=21.60, p<0.001$).
- Also, the mean values for group B pre and post treatment showed significant difference when compared (for right leg $t=18.147, p<0.001$; for left leg $t=23.63, p<0.001$).
- But when the mean difference of both the groups were compared, group A showed more significant result than group B (for right leg $t=3.186, p=0.02$; for left leg $t=3.712, p<0.001$).

12. Discussion

The hamstring muscles are commonly linked with movement dysfunction at the lumbar spine, pelvis and lower limbs and have been coupled with low back pain and gait abnormality.

The aim was to study the effect of core stability exercises versus Surya Namaskar on hamstring tightness using active knee extension test. The exercises were given 3 times per week for 6 weeks. Progression was done every week. The study included 8 males and 52 females. 5 subjects did not complete the duration of the study due to various reasons.

Although both the groups showed significant improvement in hamstring length, core stability exercises have better effect on hamstring tightness than Surya Namaskar with $p<0.001$, hence proving the alternate hypothesis H2.

This is due to the fact that the hamstring muscle has a torso of biceps femoris attached to the ischial tuberosity which is an extension of Theos. Sacrum and attached to the thoracolumbar fascia. Through this relationship it can affect tight hamstring^[11].

Pelvic tilting and supine bridging is an isometric activation exercise for core stabilisation and activation of gluteus

maximus muscle and facilitating hip extension muscles indirectly causing lengthening in the hamstring muscle but through pelvic motion.

AL Na'ima *et al.* conducted a study on 'combination effect of core stability exercise on hamstring flexibility. In this study the hamstring flexibility was assessed using sit and reach test. Core stability exercises when combined with contract relax exercises showed greater difference in increasing the hamstring length [12].

Also, Kuszewski *et al.* in their study concluded that stability training of the LPHC showed a tendency to be effective in reducing stiffness of hamstrings [13].

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 knees are extended as in standing the SBL functions as a continuous line of myofascial [14].

Hence the hamstrings get stretched through the SBL when Surya Namaskar is performed. When the muscle gets stretched there is also an increase in the number of sarcomeres in series.

A similar study performed by Mangaonkar. A, & Puntambekar. A, on effect of Surya Namaskar vs. dynamic stretching on hamstring flexibility among physiotherapy students. This study concluded that Surya Namaskar proved more effective in improving hamstring flexibility than dynamic stretching [15].

When the two interventions were compared with each other the core stability exercises showed greater statistical difference. The weak gluteals result in increased activity in the hamstrings and erector spinae as compensation to assist hip extension. The hamstrings show tightness as they attempt to pull the pelvis backward. Therefore in the core group the gluteals were strengthened along with the deep muscles, this reduced the extra load on the hamstrings and the muscle was allowed to lengthen.

13. Conclusion

The study concluded that although both the exercise interventions showed significant result in improving hamstring tightness, when compared with each other core stability exercises showed greater difference statistically.

14. Limitations

- Sample size was less
- The study was conducted on fewer males
- Objective of the study did not include reassessment of the core strength
- Only one outcome measure was used to assess hamstring tightness

Future Scope of the Study

- This study can be done using a larger sample size
- The population consisting of more males can be used for the study
- Post intervention core strength can be assessed to study the effect of these exercises on core muscles
- Hamstring tightness can be measured using two or more outcome measures

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