

# Effect of Active Release Technique Versus Active Isolated Stretching Technique on Hamstring Flexibility in Badminton Players

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## ABSTRACT

### BACKGROUND AND OBJECTIVE:

Badminton is one of the most widely played racket sports around the globe. Known for its fast pace and technical precision, it involves quick, explosive movements across the court. The performance of a badminton subject depends on a variety of factors such as body composition, physical fitness, and motor skills. Main objective of this study was to compare the 'effect of active release technique versus active isolated stretching technique on improving hamstring flexibility in badminton players'

**METHODS:** Quasi experimental study. In this study, 154 subjects were screened between the age group of 18 years and above, and according to inclusion and exclusion we included 144 subjects were randomly allocated into two groups, each group containing 72 subjects. Group- A received Active release technique 'and Group-B received Active isolated stretching technique '. Subjects received 3 sessions in a week for 4 weeks. The outcome measures were

measured in term of active knee extension test for hamstring flexibility.

**RESULTS:** Independent t-test was used to compare the mean significance difference between continuous variables. Paired t-test was used to assess the statistical difference between pre-test and post-test scores. Statistical analysis of the data revealed that within the group comparison, both groups showed significant improvement in all parameters. Whereas in between group's comparison active release technique showed better improvement.

**CONCLUSION:** After four weeks of training both the groups showed significant improvement. Group-A, who received active release technique showed better and effective results.

**Keywords:** Active Release Technique, Active Isolated Stretching Technique, Active Knee Extension Test, Hamstring Flexibility, Badminton Players.

## **INTRODUCTION**

Badminton is one of the most widely played racket sports around the globe. Known for its fast pace and technical precision, it involves quick, explosive movements across the court.<sup>[1]</sup> The performance of a badminton subject depends on a variety of factors such as body composition, physical fitness, and motor skills. To perform efficiently during a match, subject must have excellent balance and agility. These attributes help them move swiftly and effectively around the court. A strong core further contributes to better stability and dynamic balance, both of which are critical for high-level performance.

The sport demands bursts of high-intensity effort with short periods of rest, making it an intermittent and physically demanding game. A subject's success in badminton is influenced by a combination of speed, agility, flexibility, explosive and strength, and muscular endurance.<sup>[2]</sup> Despite being a non-contact sport, the nature of its rapid, repetitive, and explosive actions such as lunging, jumping, and quick directional shifts can put strain on joints and muscle groups, leading to imbalances or dysfunction.<sup>[3]</sup>

Among the various movement patterns in badminton, the lunge is one of the most frequently performed, making up around 15% of all movements during a game.<sup>[4]</sup> A typical lunge involves a rapid step forward, followed by a quick return to the base position to get ready for the next shot. Because lunges are repeated frequently and performed at high speed, they can put considerable stress on the lower limbs particularly during the moment the heel makes contact with the ground resulting in a higher incidence of injuries in the lower extremities.

Badminton attracts subject of all ages, genders, and skill levels across the world. One of the most crucial aspects of the game is footwork, which allows subjects to reach shots effectively and quickly return to their ready position. Lunges, being among the most commonly used footwork techniques, demand a high level of muscle engagement

and dynamic stability in the core and knees to manage the constant changes in body direction.<sup>[5]</sup>

Lunges in badminton can be performed in four main directions, but forehand and backhand forward lunges are used most often during play.<sup>[6]</sup> Backhand forward lunges produce greater ground reaction forces and higher plantar pressures in right-handed players, indicating a higher injury risk compared to forehand lunges. Backhand lunges involve significantly lower stress on the hip, knee, and ankle joints in the frontal plane than forehand lunges, potentially reducing the likelihood of overuse injuries.<sup>[7]</sup> Flexibility, defined as the ability to move joints and muscles freely through their full range of motion without pain or restriction, plays a major role in both general health and skill-based physical fitness. Good hamstring flexibility, in particular, helps reduce the risk of injury and enhances athletic function. Unfortunately, limited flexibility in the hamstrings is widespread, affecting about 68% of people globally.<sup>[8]</sup>

The hamstring is a large muscle group located at the back of the thigh, consisting of the semitendinosus, semimembranosus, and both the long and short heads of the biceps femoris. These muscles cross both the hip and knee joints, originating from the ischial tuberosity and attaching to the upper parts of the tibia and fibula. As muscles that span two joints, they are involved in extending the hip, flexing and rotating the knee, maintaining posture, supporting the pelvic position, and assisting trunk movement relative to the lower body.<sup>[9]</sup>

A lack of flexibility in the hamstrings can limit movement range and sometimes cause discomfort or pain when extending the knee. Flexibility, in general, refers to the ability of muscles and tendons to elongate without restriction.<sup>[10]</sup> Reduced flexibility can lead to several biomechanical issues, including poor posture and joint dysfunction. This typically happens because of the adaptive shortening of muscles, tendons, and surrounding soft tissues.<sup>[11]</sup> When the hamstrings are tight, their length decreases, restricting movement.

On the other hand, improved flexibility enhances efficiency in movement and lowers the likelihood of muscle strains.<sup>[12]</sup>

In badminton, high flexibility is crucial for subject to perform difficult, extended movements. For example, better backward bending ability during a smash can contribute to more powerful and technically sound shots.<sup>[13]</sup> The kinetic chain principle in badminton explains how energy is transferred through the body in a sequential and coordinated way—from the ground up through the legs, hips, lower and upper back, neck, shoulders, arms, and finally the racket. This neuromuscular synchronization is essential for generating the required speed and power during strokes.<sup>[14]</sup> To maintain optimal performance, players must develop strength, coordination, balance, agility, and flexibility. These physical attributes all play a crucial role in how efficiently and effectively a player moves on the court.<sup>[15]</sup>

Biomechanical analysis focuses on how the body moves and the forces involved during specific strokes, particularly the smash. Elite players tend to show more efficient and well-coordinated muscle activation patterns during these high-impact movements. Typically, landings after a jump smash are performed on one foot, followed by contact with the other.<sup>[16]</sup> Recreational players, especially those with less muscle strength, often show less ankle dorsiflexion upon landing, which can increase the risk of injury. Fatigue can further reduce plantar flexion during landing, compounding the injury risk.<sup>[17]</sup>

Two notable techniques for improving flexibility are Active Release Technique (ART) and Active Isolated Stretching (AIS). Active Release Technique is a manual therapy method that targets tension and adhesions in soft tissues caused by repetitive use. It involves the therapist applying pressure while moving the tissue to break up cross-fibre adhesions that limit smooth movement. This technique restores normal tissue function and helps improve range of motion, ultimately boosting athletic performance.<sup>[18]</sup>

Active Isolated Stretching, on the other hand, focuses on improving muscle flexibility by using brief, controlled stretches. The process involves activating the agonist muscle, which triggers a reflex that allows the opposing muscle to relax. This technique avoids overstimulating the stretch reflex by holding each stretch for no longer than two seconds. AIS is particularly effective for increasing hamstring flexibility and joint range in healthy individuals.<sup>[19]</sup>

Therefore, the purpose of this study is to investigate the effect of active release technique versus active isolated stretching technique on hamstring flexibility in badminton players.

## **MATERIALS & METHODS**

This is a Quasi experimental study design approved by the Ethical Committee of GSL medical college and general hospital. The study was conducted for period of 1 year, from July 1<sup>st</sup> 2024 to June 30<sup>th</sup> 2025 at sports arena of physiotherapy college campus. 154 subjects were screened between the age group of 18 years and above, and according to inclusion and exclusion we included out of which 144 subjects were randomly allocated into two groups, each group containing 72 subjects. Informed consent will be obtained from the participants and demographic data will be recorded. Group-A received active release technique and Group-B received active isolated stretching technique. Subjects received 3 sessions in a week for 4 weeks. The active knee extension test was used for hamstring flexibility to evaluate both the groups before and after the intervention.

**Inclusion criteria:** Age – 18 years and above college going badminton playing subjects, male and female subjects were included, hamstring flexibility less than or equal to 90 degrees is considered according to standard SLR test, subjects who voluntarily gave consent to participate in the study.

**Exclusion criteria:** History of lower extremity musculoskeletal abnormalities, joint hypermobility, neurological

abnormalities, cardio respiratory abnormalities, skin lesions.

### OUTCOME MEASURES

Pre-test and post-test measures were taken by using active knee extension test. All the subjects underwent a protocol treatment of 3 days per week for 4 weeks duration.

**ACTIVE KNEE EXTENSION TEST:** In order to administer the AKE test, participants must lie supine on a plinth with their knees extended and the leg not being tested flat on the plinth. To prevent any elevation of the limb, a strap will be positioned over this leg's mid-thigh. To keep the participant's pelvis in a neutral position during hamstring measurements, an extra strap will be placed around the plinth and over the front of the pelvis. A standard universal goniometer will be positioned over the lateral femoral condyle with the foot in neutral and the knee flexed at a 90-degree angle. One arm will be positioned along the thigh toward the greater trochanter, while the other arm will be positioned over the leg toward the lateral malleolus.<sup>[20]</sup>

In order to obtain the goniometric reading, individuals will be instructed to extend their knees from this position until they experience a considerable resistance. They will then be required to hold this final position for two to three seconds. Starting from the initial test position (knee flexed at 90 degrees, which corresponded to the goniometric 0 degrees), the recorded result matched the amplitude, in degrees, of the knee-extension movement.

### INTERVENTION

#### GROUP A: ACTIVE RELEASE TECHNIQUE:

Treatment protocol: GROUP-A: Subjects will receive active release technique. There are 3 steps to perform ART.

Step 1: Subjects lies supine on the plinth and mild tension will be given to the hamstring muscle along the entire length while stretching the leg in different positions to better work the muscle.

Step 2: Tension will be applied along the hamstring muscle.

Step 3: Tension will be applied around the

adductors and gluteus muscle because hamstring connects to these muscles and that can be the source of hamstring tightness.

Holding the contact for 5-20sec repeated 5 times rest between the sets, At a frequency of three days a week for four weeks duration.<sup>[18]</sup>



Fig:1 Subject performing active release technique

#### GROUP B: ACTIVE ISOLATED STRETCHING TECHNIQUE:

Hamstring active isolated stretching Before the stretching session, the investigator explains and demonstrates the hamstring AIS technique to each participant. The subjects will be positioned on a table as in the hamstring flexibility test. However, subject receives an intervention to stretch the hamstring musculature. Then, the individuals will be instructed to extend their knee actively as much as possible while relaxing plantar flexor groups. Each stretch will be held for no more than 2 seconds; it is recommended to exhale on the stretch and inhale on the release/relax. The investigator then monitors and masters every movement during active hamstring stretching. The stretching consists of 3 sets of 10 repetitions with a 2-second rest between the repetitions and a 5-minute rest between the sets. At a frequency of three days a week for four weeks duration.<sup>[19]</sup>



Fig:2 Subject performing active isolated stretching technique.

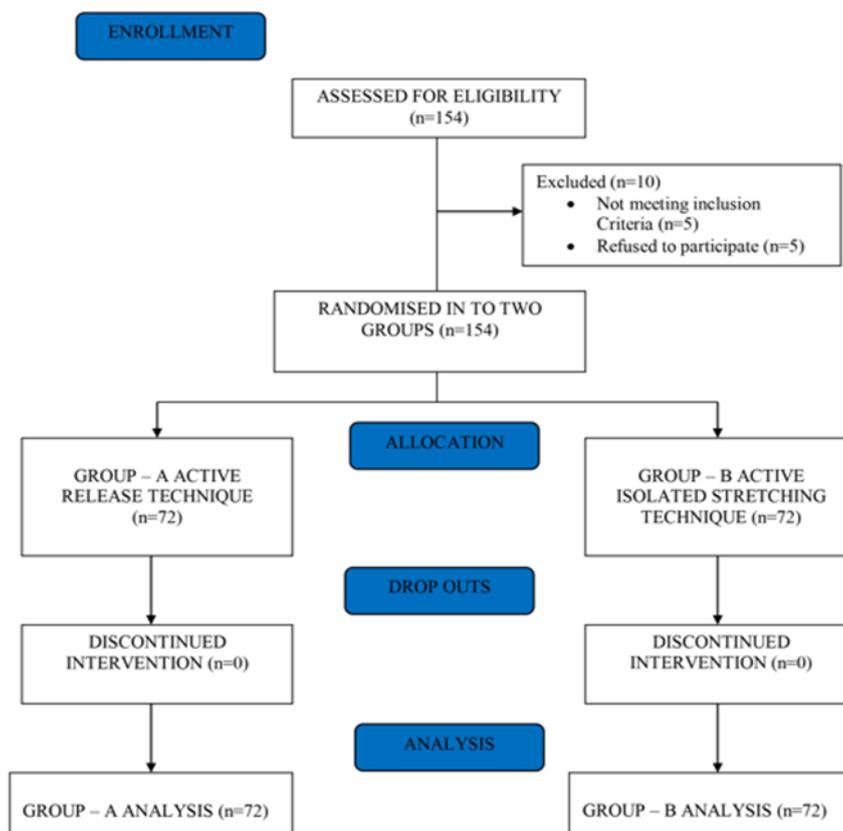


Figure 3: Consort Flow Chart of Study Participants from Enrollment to Analysis

### Statistical Analysis

Statistical analysis was done by using SPSS software version 20.0 and Microsoft excel 2019. All Descriptive data was presented in the form of mean  $\pm$  standard deviation and mean difference percentages were calculated and presented. Within the groups paired t-test was used to compare the levels of pre and post test scores. It was used to assess the statistical difference within the groups for active knee extension test using universal goniometer. Between the groups unpaired t-test was used to compare the statistical difference between means of two independent group for active knee extension test using universal goniometer. Data was tabulated and graphically represented. For all statistical analysis,  $p < 0.05$  was considered as statistically significant.

### RESULT

The results of the study were analysed in terms of active knee extension test. The consort flowchart of the study showed the

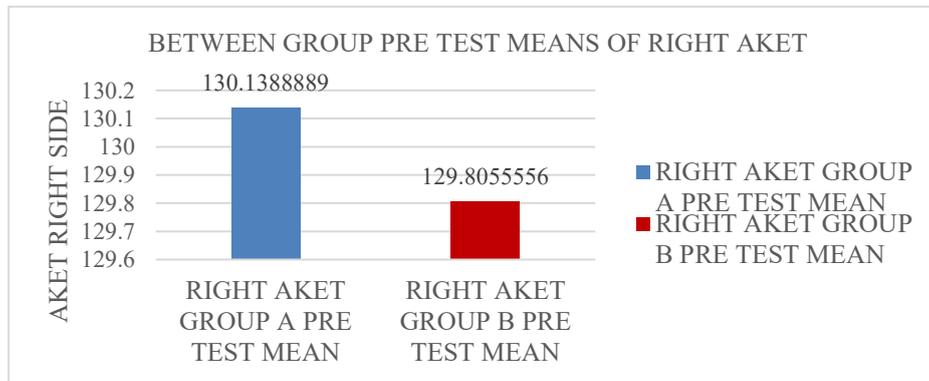
study organization in terms of subject's enrollment, screening, allocation and analysis following intervention as shown in figure 3.

The study compared the effect of active release technique versus active isolated stretching technique on hamstring flexibility in badminton players. A total of 154 subjects were screened for eligibility among them 144 students were recruited under the inclusion and the exclusion of the study. Each participant was randomly assigned to one of two groups, each consisting of 72 players, after completing baseline assessments. Training was conducted three times a week for four weeks. At the end of the intervention, all 144 participants, 72 in Group A and 72 in Group B completed the training. At a significance level set at  $p \leq 0.05$ , both the groups demonstrated statistically significant improvements in active knee extension test scores with group A being more effective than group B.

**COMPARISON OF MEAN SCORE OF RIGHT ACTIVE KNEE EXTENSION TEST IN BETWEEN THE GROUPS AT BASELINE (A&B)**

RIGHT AKET		MEAN	STANDARD DEVIATION	P VALUE	INFERENCES
PRE TEST	GROUP A	130.13	3.08	0.51	INSIGNIFICANT
	GROUP B	129.80	2.99		

TABLE I



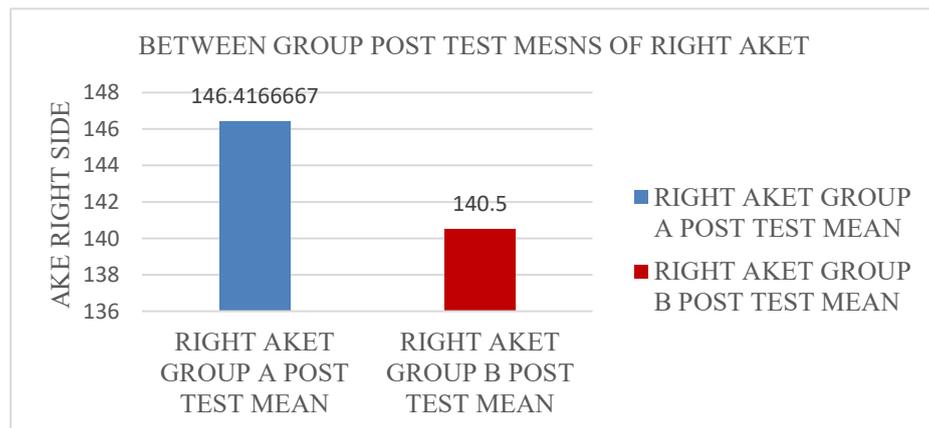
GRAPH I

**RESULTS:** The data presented in Table 1 and Graph 1 indicate that the comparison of the mean score of right active knee extension test at pre-test between Group A (130.1) and Group B (129.8) showed no statistically significant difference ( $p < 0.05$ ).

**COMPARISON OF MEAN SCORE OF RIGHT ACTIVE KNEE EXTENSION TEST IN BETWEEN THE GROUPS AT POST TEST (A&B)**

RIGHT AKET		MEAN	STANDARD DEVIATION	P VALUE	INFERENCES
POST TEST	GROUP A	146.41	4.47	0.001	HIGHLY SIGNIFICANT
	GROUP B	140.5	3.76		

TABLE II



GRAPH II

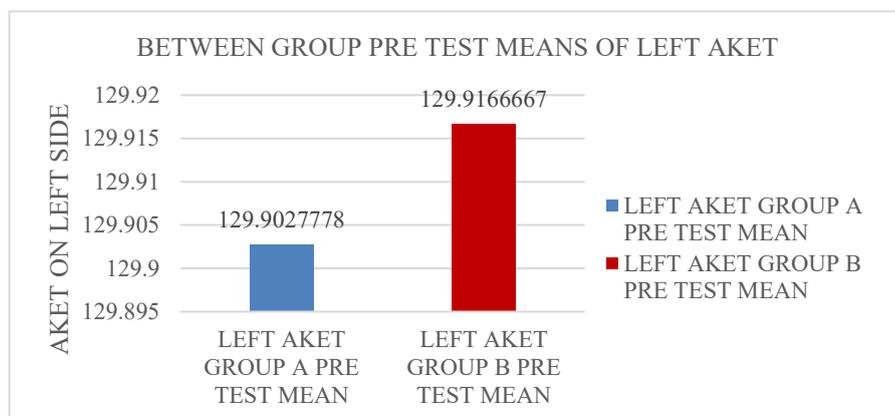
**RESULT:** The data presented in Table 2 and Graph 2 show that the post-test mean score of the right active knee extension test was 146.4 for Group A and 140.5 for Group B. This difference between the groups was

found to be statistically significant ( $p < 0.05$ ).

**COMPARISON OF MEAN SCORE OF LEFT ACTIVE KNEE EXTENSION TEST IN BETWEEN THE BASE LINE (A&B)**

LEFT AKET	MEAN	STANDARD DEVIATION	P VALUE	INFERENCES
PRE TEST	GROUP A 129.90	2.99	0.98	INSIGNIFICANT
	GROUP B 129.91	2.98		

TABLE III



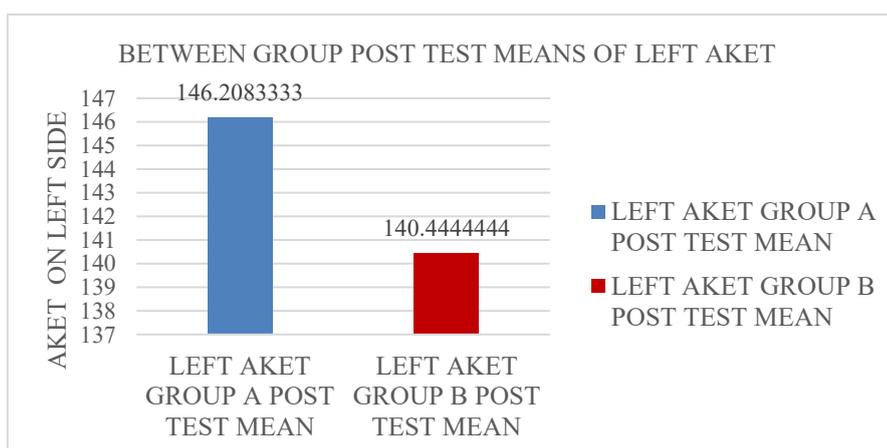
GRAPH III

**RESULT:** The data presented in Table 3 and Graph 3 shows that the mean score of left active knee extension test at pre-test were the same for Group A (129.9) and Group B (129.9). This comparison showed no statistically significant difference ( $p < 0.05$ ).

### COMPARISON OF MEAN SCORE OF LEFT ACTIVE KNEE EXTENSION TEST IN BETWEEN THE POST TEST (A&B)

LEFT AKET	MEAN	STANDARD DEVIATION	P VALUE	INFERENCES
POST TEST	GROUP A 146.20	4.82	0.001	HIGHLY SIGNIFICANT
	GROUP B 140.44	3.73		

TABLE IV



GRAPH IV

**RESULT:** The data presented in Table 4 and Graph 4 shows that the mean score of left active knee extension test at post-test were 146.2 for Group A and 140.4 for Group B. This difference was found to be statistically significant ( $p < 0.05$ ).

### DISCUSSION

The main aim of this study was to compare the effects of Active Release Technique and Active Isolated Stretching on improving hamstring flexibility in college-level badminton players. Hamstring flexibility was

assessed using the Active Knee Extension Test with a goniometer. A total of 144 participants were randomly divided into two groups, where Group A received Active Release Technique and Group B received Active Isolated Stretching. Both groups underwent a four-week training program with three sessions per week. All participants were evaluated before the intervention and again after completing the four-week program.

By the end of the four-week program, participants in Group A who received the Active Release Technique showed a significant improvement in hamstring flexibility, as reflected by the change in the Active Knee Extension Test mean score ( $p = 0.0001$ ).

Group B, which received the Active Isolated Stretching technique, also demonstrated a significant increase in hamstring flexibility, with the Active Knee Extension Test mean score showing similar statistical significance ( $p = 0.0001$ ). Group A participants received active release technique showed significant improvements in hamstring extensibility.

ART is believed to work by breaking down myofascial adhesions, restoring normal muscle length, and improving tissue mobility. This effect can enhance neuromuscular coordination and increase the efficiency of muscle contraction, contributing to functional performance benefits. Sarfraj Khan et al who proved that the effectiveness of active release technique and muscle energy technique in subjects with hamstring tightness. Statically there is significant ( $p < 0.05$ ) effect of active release technique than the muscle energy technique on subjects with hamstring tightness. Similarly, the current study is a four weeks program the participants in Group A who underwent Active Release Technique showed a significant improvement in hamstring flexibility, as reflected by the marked changes in the Active Knee Extension Test, with a mean score demonstrating strong statistical significance ( $p = 0.0001$ ).<sup>[20]</sup>

Another study by Sachin Maghade, Keerthi

Rao et al who proved that immediate effect of active release technique and dynamic soft tissue mobilization on tightness of hamstring in young adults. The result shows that active release technique and dynamic soft tissue mobilization increases immediate post-intervention hamstring flexibility within the group was insignificant on comparison between two groups. However DSTM technique showed immediate relief in hamstring tightness pain and was more comfortable and effective for the patient as compared to ART.<sup>[21]</sup>

Another study conducted by Syed Rais et al., study compared the immediate effects of Muscle Energy Technique and Active Release Technique on hamstring tightness in football players, pre- and post-treatment assessments were carried out using the Active Knee Extension Test and the Sit and Reach Test. The findings showed that both MET (PIR) and ART helped reduce hamstring tightness and improved knee extension range of motion in both recreational and professional footballers. However, ART produced a significantly greater improvement, making it more effective than MET in enhancing hamstring flexibility and knee extension.<sup>[22]</sup>

According to Dr. Apeksha Vaghasiya et al., conducted to see immediate effects of active release technique and foam rolling on hamstring tightness in computer workers, a paired t-test was conducted for within-group analysis and revealed significant improvements in active knee extension tests in both groups. An unpaired t-test was then used to compare the groups, and the results showed that ART produced a greater reduction in hamstring tightness than foam rolling. The level of significance was set at  $p < 0.05$ .<sup>[23]</sup>

Another study by Dr. Shrunkhala Kaushik et al., conducted immediate effects of active release technique versus muscle energy technique on hamstring tightness in sewing machine operators. pre and post measurements of active knee extension test and sit and reach test was taken, there was significant reduction in hamstring

tightness( $p=0.0001$ ) in both techniques. Statistical comparison of both techniques proved that Active Release Technique was more effective than Muscle Energy Technique.<sup>[24]</sup>

A study conducted by Muniba Afzal Dar et al., Compare the effects of active release technique and post-isometric relaxation in treatment of plantar fasciitis in traffic police wardens. compared within-group differences in the VAS score and FFI using paired t tests and analyzed between-group differences in the VAS score and FFI before and after performing the ART and PIR using independent t tests. They concluded that active release exercise intervention is more effective than post-isometric relaxation on improving pain and foot function disability in plantar fasciitis patients.<sup>[25]</sup>

Group B participants received Active isolated stretching technique, AIS functions differently, utilizing the principle of reciprocal inhibition, where contraction of the agonist muscle facilitates relaxation of the antagonist. This neurophysiological mechanism allows muscles like the hamstrings to elongate more safely and effectively. According to Gurkan Gunaydin et al., Research has shown that various stretching techniques, such as static and dynamic methods, are commonly used in clinical practice, but it is still unclear which approach is most effective for improving flexibility or how they influence performance. This study aimed to compare the long-term effects of active isolated stretching, ballistic stretching, and static stretching on hamstring flexibility and performance. The findings indicated that long-term stretching programs improved hamstring flexibility, with active isolated stretching and ballistic stretching producing the most notable gains.<sup>[26]</sup>

A study by Suman Sheraz et al., this study compared the effects of Active Isolated Stretch and Post Isometric Relaxation on improving hamstring flexibility in young, healthy adults. Flexibility was assessed at baseline, immediately after the first and final exercise sessions to evaluate short-term

effects, and again two weeks after the final session to determine long-term effects. Both techniques were equally effective in their immediate, short-term and long term effects on hamstring flexibility.<sup>[27]</sup>

Another study by Cem Kurt et al., Effects of traditional stretching versus self-myofascial release warm-up on physical performance in well-trained female athletes. Hamstring flexibility was measured using a sit-and-reach test. All athletes performed the three interventions in a randomized order with 72-hour intervals between sessions. The results showed that both jump height and hamstring flexibility improved significantly more following dynamic stretching compared to self-myofascial release (SMR) and static stretching. Dynamic stretching and SMR showed better flexibility, strength, and jump performance than SS.<sup>[28]</sup>

According to Atharva S. Hegishte et al., Effect of proprioceptive neuromuscular facilitation and dynamic stretching on flexibility, agility, and balance in hamstring tightness among collegiate level badminton players. Group A and Group B demonstrated significant improvement in Flexibility, Balance, and Agility ( $p<0.0001$ ).

Whereas, no significant difference was seen when intergroup comparison was done ( $p>0.005$ ). The study concludes that there is significant improvement in the Flexibility, Balance, and Agility after implication of 4 weeks of PNF and Dynamic Stretching in Collegiate Level Badminton players having Hamstring tightness.<sup>[29]</sup>

Esther Liyanage et al. conducted a network meta-analysis to examine the effectiveness of different physiotherapy interventions on hamstring flexibility in university students with hamstring tightness. Compared with no treatment, all interventions—such as stretching, stretching with electrotherapy, massage, dry needling, and neurodynamic exercises—showed superior outcomes. When interventions were compared directly with stretching, neurodynamic exercises, both alone and in combination with stretching, demonstrated greater effectiveness, whereas electrotherapy

provided no added advantage. Overall, neurodynamic exercises emerged as the most beneficial approach, although the quality of evidence was low. Adequate hamstring flexibility is essential in badminton due to frequent lunges, sprints, and jumps that impose high eccentric loads. Therefore, the flexibility gains observed in the present study carry meaningful clinical and functional implications for badminton performance.<sup>[30]</sup> The present study demonstrated several methodological strengths, including a large sample size of 144 participants, a sport-specific population, and the use of a standardized four-week intervention protocol, with Active Knee Extension as the primary outcome measure. Compared to previous studies, which often relied on small sample sizes and single-session interventions, this design provides greater reliability and practical relevance for badminton players.

Similarly, a study by Fizza Ali Syed et al. investigated the effects of Active Release Technique and Active Isolated Stretching on muscles affected by Upper Cross Syndrome. That study was a single-blinded randomized clinical trial, using Vernier calipers and measuring tape to assess muscle length between standard bony landmarks, along with tools such as the Neck Disability Index, cervical rotation range of motion, craniovertebral angle, and the Numeric Pain Rating Scale for data collection. The study concluded that both ART and AIS were effective treatment methods. It was indicated that active release technique was helpful in pain relief, improving range, cranio-vertebral angle, muscle length and functional status in subjects with Upper-cross syndrome.<sup>[31]</sup>

In the present study both active release technique and active isolated stretching technique are effective on improving hamstring flexibility by using outcome measure Active knee extension test, these methodological features strengthen the evidence that ART can produce larger short-term to medium-term improvements in hamstring flexibility compared to AIS.

These methodological features strengthen the

evidence that ART can produce larger short-term to medium-term improvements in hamstring flexibility compared to AIS. ART requires a trained clinician and dedicated treatment time, making it more resource-intensive than AIS or dynamic stretching. The 2021 experimental ART reports and other clinical studies note patient discomfort may occur during aggressive manual release, whereas AIS is safe, low-cost, and ideal for pre-practice warm-ups.

## CONCLUSION

The present study concluded that a four-week program of both Active Release Technique and Active Isolated Stretching significantly improved hamstring flexibility in college-level badminton players. However, participants in Group A, who received the Active Release Technique, demonstrated superior clinical outcomes compared to the other group.

### *Declaration by Authors*

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**Conflict of Interest:** The authors declare no conflict of interest.

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