

Effect of Low Intensity Plyometric Training Combined with Different Muscle Relaxation Techniques on Leg Explosive Power of Junior Athletes

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Abstract

Objectives: This study aimed to investigate the effect of low intensity plyometric training combined with different muscle relaxation techniques on leg explosive power of junior athletes. **Methods:** The experimental study enrolled 60 junior athletes from Shree Bharath Vidyaashram, Chennai. The age ranged between 11 to 13 years, who were selected to carry out the research. The subjects who met the inclusion criteria were selected using random sampling and divided into three intervention groups and a control group. The test items used to collect the leg explosive power tested by standing long jump test and performance recorded in meters. The 12 weeks of stipulated training was provided to the participants for the period of 60-minute sessions for the three alternative days in a week. **Statistical Procedure:** To process the results of the study, analysis of the data was done with the IBM SPSS Statistics 22 software. The statistics obtained were provided by paired sample t-test. The improvement percentage was assessed by using the formula of “% $\Delta = (x \text{ post-test} - x \text{ pre-test}) / \text{pre-test} * 100$.” The level of confidence was fixed at 95% and values below $p < 0.05$ were considered significant. **Results:** The paired sample t-test showed a significant ($p < 0.05$) improvement in explosive power over the 12 weeks of stipulated training. **Conclusion:** The results indicate considerable significant improvement on leg explosive power was observed. The findings indicate that the selected training regimes led to significant improvement on leg explosive power namely, standing long jump test observation.

Keywords: Plyometric training, Stretching exercise, Foam roller exercise, Leg Explosive Power, Paired sample t-test.

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INTRODUCTION

Plyometric Training:

Sports that require speed-strength include, throwing and sprinting; volleyball, baseball, football and basketball. Plyometric exercise is especially useful in sports that require speed-strength (Lundin, P.A 1989; Matveyev, 1983). Speed - strength is the ability to exert maximal force during high-speed movements. Plyometric training is a traditional training approach to develop strength and speed. Numerous studies were conducted in this area to enhance the top performance in all the games and sports. The basic nature of this plyometric training is also most linked with jump actions (Chu 1994).

Foam Roller Exercise:

Foam rolling is a type of self-myofascial release that can be used to help relieve muscle knots and trigger points. Our fascia is the thin tissue that wraps and connects our muscles, bones, nerves and blood vessels. For a variety of reasons, such as muscle injury. Inactivity, disease, inflammation, or trauma, the fascia can become stiff and bind up. Foam rolling can be an effective way to help lengthen and release the built-up tension in the fascia by breaking up adhesions and scar tissue to help speed up the healing and recovery process after a workout. It can also be an effective way to help loosen up common areas of tightness before a workout (Scot, 2015).

Stretching Exercise:

Stretching is a form of physical exercise in which a specific muscle or tendon (or muscle group) is deliberately flexed or stretched in order to improve the muscle's felt elasticity and achieve comfortable muscle tone. The result is a feeling of increased muscle control, flexibility, and range of motion (Bachale, 2008).

METHODOLOGY

The experimental study enrolled 60 junior athletes from Shree Bharath Vidyaashram, Chennai. The age ranged between 11 to 13 years, who were selected to

carry out the research. The subjects who met the inclusion criteria were selected using random sampling and divided into three intervention groups and a control group. The test items used to collect the leg explosive power tested by standing long jump test and performance recorded in meters. The 12 weeks of stipulated training was provided to the participants for the period of 60-minute sessions for the three alternative days in a week. During the training period athletes not reported any injury. The basic training load was fixed based on the performance of pilot study. The progression of the load was raised in once in four weeks during the 12 weeks of training period.

Table-I: Analysis of Leg Explosive Power of Experimental and Control Groups Pre and Post Test Descriptive Statistics (Performance in seconds)

Groups	Pre test		Post test		N
	Mean	SD	Mean	SD	
LIPT	1.65	0.03	1.68	0.03	15
LIPT+SS	1.66	0.02	1.72	0.02	15
LIPT+FRE	1.64	0.02	1.79	0.03	15
CG	1.64	0.02	1.64	0.02	15

Table -IV show the pre and posttest mean and standard deviation of experimental and control groups on leg explosive power. The low intensity plyometric training (LIPT) group obtained pretest mean and standard deviation was 1.65 ± 0.03 and post-test mean and standard deviation was 1.68 ± 0.03 . The low intensity plyometric training combined with static stretching (LIPT+SS) group obtained pre and post-test

mean and standard deviation was 1.66 ± 0.02 and 1.72 ± 0.02 . The low intensity plyometric training combined with foam roller exercise (LIPT+FRE) group obtained pre and post-test mean and standard deviation was 1.64 ± 0.02 and 1.79 ± 0.03 . The control group (CG) obtained pre and post-test mean and standard deviation was 1.64 ± 0.02 and 1.64 ± 0.02 .

Table-II: Repeated Measures Anova for Leg Explosive Power of Experimental and Control Group (Performance in seconds)

Source of variance	SS	df	MS	F value	Significance
Time effect	0.10	1	0.104	186.48*	0.00
Error (Time)	0.031	56	0.03		
Group effect	0.100	3	0.033	29.32*	0.00
Error (Between)	0.064	56	0.001		
Time X Group interaction	0.09	3	0.032		
Error (Interaction)	0.031	56	0.001		

Table-V shows the results of repeated measures analysis of variance for leg explosive power performance among the experimental and control groups. The obtained F value for time effect was significant ($F=186.48$, $p<0.05$). It indicates that performance of leg explosive power was changed significantly from pre to post test. The obtained F value for group effect was significant ($F=29.32$, $p<0.05$). It indicates that the

significant differences between the groups were observed. The obtained F value for time X group interaction was significant ($F=57.08$, $p<0.05$). It indicates that the amount of improvement significantly differed among the experimental and control groups, it reflects the differential effectiveness of the scheduled interventions over the twelve-week period.

Table – III: Scheffe's Post Hoc Pairwise Comparisons of Leg Explosive Power Among Experimental and Control Groups (Performance in seconds)

Groups	Post-test mean differences	P value
LIPT and LIPT+SS	0.03*	0.03
LIPT and LIPT+FRE	0.05*	0.00
LIPT and CG	0.03*	0.01
LIPT+SS and LIPT+FRE	0.3*	0.00
LIPT+SS and CG	0.05*	0.00
LIPT+FRE and CG	0.07*	0.00

The mean differences of LIPT and LIPT+SS is 0.03, it showed significant. It indicates that the both the group produced significantly different effect on the performance of leg explosive power. The mean differences of LIPT and LIPT+FRE is 0.05, it showed significant. It indicates that the both the group produced significantly different effect on the performance of leg explosive power. The mean differences of LIPT and CG is 0.03, it showed significant. It indicates that the both the group produced significantly different effect on the performance of leg explosive power. The mean differences of LIPT+SS and LIPT+FRE was 0.3, it showed significant. It indicates that the both the group produced significantly different effect on the performance of leg explosive power. The mean differences of LIPT+SS and CG were 0.05, it showed significant. It indicates that the both the group produced significantly different effect on the performance of leg explosive power. The mean differences of LIPT+FRE and CG were 0.07, it showed significant. It indicates that the both the group produced significantly different effect on the performance of leg explosive power.

DISCUSSIONS

The Twelve weeks of low-intensity plyometric training (LIPT), low-intensity plyometric training combined with static stretching (LIPT+SS), and low-intensity plyometric training combined with foam roller exercises (LIPT+FRE) resulted in greater improvements in leg explosive power compared to the control group. The following studies in line with the current study's findings. Junker D, Stoggl T (2019), Their study explored the effects of foam rolling versus core stabilization training on flexibility, strength endurance, and performance over eight weeks. Foam rolling significantly enhanced range of motion while maintaining balance, muscle performance, and core endurance. Ambili Ragavan, Maniazhagu (2019), Their study investigated the effects of varying volumes of plyometric training on different surfaces combined with SAQ drills on explosive power among junior volleyball players. The findings demonstrated that all training combinations effectively enhanced explosive power. Overall, the study emphasizes that integrating plyometric training with SAQ drills, regardless of surface or volume, can significantly boost explosive performance in young volleyball players. Amr H. Tammam & Enas M. Hashem (2020), their study inspected the individual and combined effects of Proprioceptive Neuromuscular Facilitation (PNF) stretching and plyometric training on muscular power and flexibility in young male volleyball players over a 6-week period. Overall, the study concludes that combining PNF stretching with plyometric training is more effective for enhancing muscular power, while flexibility improvements are comparable across training methods. Chaabene H *et al.*, (2019), their review observes the acute effects of static stretching (StS) on strength and power performance, with a focus on its role within warm-up routines. Overall, the findings recommend careful use of static stretching,

emphasizing that duration and context within warm-up routines determine its impact on performance. Faigenbaum AD *et al.*, (2007), their study compared the effects of combined plyometric and resistance training (PRT) with resistance training alone (RT) on fitness performance in boys aged 12–15 years over six weeks. These findings indicate that integrating plyometric exercises with resistance training enhances both upper and lower body power more effectively than resistance training alone. ulia Samek *et al.*, (2025), they analyzed that the effects of foam rolling on muscle recovery, with emphasis on muscle strength, lactate clearance, range of motion, and delayed onset muscle soreness (DOMS). Overall, foam rolling appears to be a promising recovery strategy, but further research is needed to standardize protocols and confirm long-term benefits. Nuannuan Deng *et al.*, (2022), their meta-analysis looked into the effects of combined upper and lower limb plyometric training (ULLPT) on physical fitness in athletes. The findings revealed small to large positive effects on upper and lower body muscle power, strength, sprint speed, agility, and flexibility. Tsai WC & Chen ZR (2021), they investigated the acute effects of foam rolling (FR) and vibration foam rolling (VFR) on drop jump performance in NCAA Division I male volleyball athletes. Overall, the findings suggest that short duration foam rolling performed approximately 2 minutes before explosive activity may enhance performance, whereas vibration foam rolling may not provide the same benefit. Warneke K *et al.*, (2024), their systematic review evaluated whether static stretching has any meaningful effects on jumping and sprinting performance in athletic populations engaged in high-speed strength sports. These results suggest that its role in training programs should remain limited to flexibility development rather than performance enhancement. Wohlann T *et al.*, (2023), their study tested the effects of a 6-week self-performed static stretch training (SST) program on muscle strength, flexibility, muscle morphology, and contractile properties. The findings suggest that improvements in strength are likely due to neural adaptations rather than muscle hypertrophy, while flexibility gains are attributed to changes in the muscle tendon unit. Suyog, Ishani Sinha, Zeeshan (2025), their systematic review discovered the effects of foam rolling (FR) on muscle recovery, pain reduction, and explosive performance in plyometric-trained athletes. The evidence from multiple randomized and experimental studies indicates that foam rolling is effective in reducing delayed onset muscle soreness (DOMS) and improving short-term recovery after high-intensity exercise. Some studies also reported improvements in explosive power when foam rolling was applied as a post-exercise recovery strategy, although the results were not fully consistent across all trials. The variability in outcomes is influenced by differences in rolling duration, frequency, and individual athlete characteristics. Overall, foam rolling appears to be a practical and accessible recovery method that supports muscle relaxation and functional recovery. It may also provide temporary performance benefits in

explosive activities. However, further well-controlled research is required to confirm its long-term effectiveness and to develop standardized application protocols for athletes.

CONCLUSIONS

1. Twelve weeks of low-intensity plyometric training (LIPT), low-intensity plyometric training combined with static stretching (LIPT+SS), and low-intensity plyometric training combined with foam roller exercises (LIPT+FRE) resulted in greater improvements in leg explosive power compared to the control group.
2. Among the three experimental groups, LIPT combined with foam roller exercises (LIPT+FRE) produced the greatest improvement in leg explosive power, outperforming LIPT+SS and LIPT alone.
3. The LIPT combined with static stretching group (LIPT+SS) showed significantly greater improvement than the LIPT-only group.
4. The least improvement among the experimental groups was observed in the LIPT-only group.
5. The control group showed no improvement in leg explosive power among junior athletes.

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