

Effect of plyometric exercises in rehabilitation of fast bowlers with ankle injury

Abstract

Background

The plyometric training has been proposed to improve the power, strength and speed of the athletes it is commonly used in the rehabilitation of the lower extremity and upper extremity

Objective

To study the effect of plyometric and strength training in the rehabilitation of ankle injury in u-19 fast bowlers

Method

This study is performed for six week, in first and second week exercises performed 2 repetition on Thursday and Friday, third and fourth week 3 repetition on Monday, Thursday and Friday, in fifth and sixth week 4 repetition is done on every alternative day. All participants aged between 18-19 years old and playing in respected under-19 level. All players were assigned into 2 groups by fish blowing method. Plyometric group (n=30) and strength training group (n=30). The 40m sprint is analysis by the two way of performance i.e. group and time, the balance is measured by the Y balance test, endurance is measured by the YO YO intermittent recovery test, and vertical jump test is used to measure the jump. And the triple hop test is used to measure the ankle strength and power.

Result

The plyometric group is significantly improved into 4 outcome variables as compare to the 5 variables (40m sprint ($p<0.001$), vertical jump ($p<0.01$), YO Y O ($p<0.037$) and triple hop($p<0.048$) while the strength training group is slightly improved into only one outcome variable(balance ($p<0.01$) out of 5 outcome variables.

Conclusion

The plyometric group showed a higher improvement as compare with the strength training group

Keyword : ankle sprain, ankle instability, balance , y o yo ,40m sprint , vertical jump, triple hop

Introduction

The fast bowlers need the strength and power to deliver the ball. The ankle injury is common injury in cricket and football³. In cricket it commonly occur because of tricky action of fast bowlers which required force, full contact of the foot with the ground after jumping just prior to releasing the ball². The ankle sprains are one of the most common musculoskeletal injury with the high incidence rate among the athletes⁴. it is important to understand the causes of the injury so as planned to appropriated prevention and treatment strategies. It is necessary to improve the musculoskeletal health and reducing the load over the ankle joint and knee joint⁵. There are some new techniques' which are used to improve the jumping and squirting ability due to excessive load over the ankle and foot joint while running and jumping just prior to deliver the ball³. The ankle joint has some risk factors which may lead to ankle injury like poor balance ligament laxity, poor proprioception and etc⁴. the bowling is the high intensity game which requires full power before deliver the ball and good balance after deliver the ball if the bowlers having poor balance then it most commonly lead to injury while deliver the ball which is commonly seen in the cricket matches⁶ and it is the major cause of the ankle twisting or other injury in fast bowlers. The bowling generally required running, jumping mid bound back foot contact and front foot contact to gain all of these the fast bowlers need agility, flexibility, strength and the endurance³. The foot contact after deliver the ball is most important because if it is not in contact with the ground properly it may results into the foot twisting which may cause the breakdown of the ankle ligament⁴. The common injury are found at the ankle joint during the jumping and landing over the ground, at least 10 times more body weight is applied to the ankle joint which creates the excessive shock at the ankle joint⁵. Generally the landing involves both the leg but in the cricket in fast bowling the one foot comes in the contact with the ground followed by other³. The single leg jumping and landing is more risky and this is required in bowling thus imposing more stress on the ankle joint and making it more prone to developed ankle injury. it is more occur in the single leg task like bowling⁴. The plyometric is a types the high intensity training which increase the muscular strength through the repeated concentric and eccentric contraction⁵. although the effect of the plyometric exercises have been investigated on several occasions⁴ it also have an effects over the kinetic and kinematic of bowling⁶. The plyometric training has proven one of the more effective ways of improving the rate of force development, sprinting and jumping activity⁴. The plyometric training is like a bridge between the speed and agility.. It is used extensively as a method of augmenting dynamic athletic actions such as sprinting, change in direction and jumping performance⁶.The balance control is one of the most important aspects in the sports for the prevention of any injury because the balance is the main cause of ankle injury⁴. The better balance is strongly positively linked with the improvement of athletic performance and negatively with the limb sports injury³.

Aims and objective

The main goal of this study is to see the effect of the plyometric exercise in rehabilitation of fast bowlers with ankle injury

Objectives

To asses the effect of plyometric and strength, balancing training on balance (y balance test)

To asses the effect of plyometric and strength, balancing training on endurance(yo yo test)

To asses the effect of plyometric and strength, balance training on functional performance (sprint test)

To asses the effect of plyometric and strength, balancing training on explosive strength(vertical jump)

Method

This is an experimental trial registered in the CTRI/2022/01/040792 registry no. The ethical clearance was obtained from the ethical committee of Amity university. This study was conducted the month of January 2022 to April 2022 we recruit subjects were recruited from the various academies of Delhi, Amity university Noida the subject recruited were eligible for participation, except those not fulfill inclusion criteria

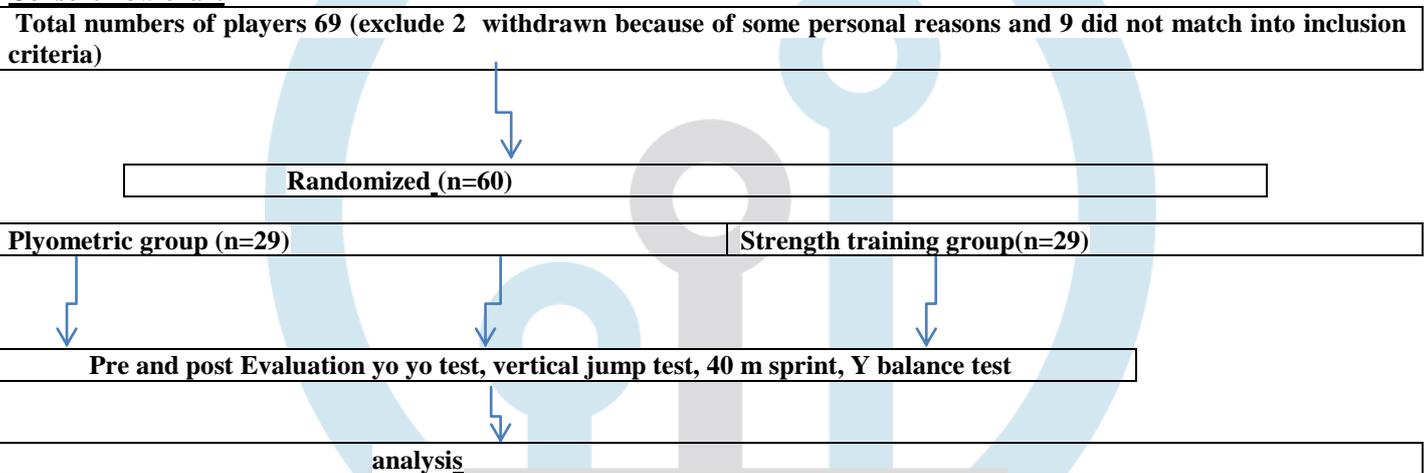
participants

The subjects were enrolled from different team of cricket between the age of 18-19 playing in u- 19 level in their respective teams and gave their consent to participate in the study to performed for six week,

Randomization of participation

1. The subjects were recruited by the fish blowing method for plyometric group and strength training group. Those who met the inclusion criteria were recruited for the study like all the players who had the ankle injury, All should be state level player, All the player should be under 19 years age, All players should be engage in 4 hour duration of training every day. All players should play atleast one match per week, Triple hop test score should be less than 10 percent less of affected limb then the unaffected limb. And participants were exclude if having player having injury of knee, back. Head, neck and other injury during study, If player is off season, Player with any infection and open wound, If player have feeling of any type of pain while running and other activity, Heart rate and respiratory problem while any physical activity, Player having infectious skin allergy. All participants were divided into equal numbers in two groups the intervention group and the strength training group. The numbering 1 for the plyometric group and numbering 2 for strength training group.

Consort flow chart



Triple hop test

The triple hop test is commonly used to assess the functional strength, power or neuromuscular control of the lower limb. The assessment of the person's ability to reduce the movement by the landing the jump at a single foot without a step.

Testing procedure:

the athlete should begin by standing on the designated test leg, with their toe on the starting line. When ready the athlete will perform 3 regular maximal hops forward with the designated leg the tester will measure the distance hopped from the starting line to the point where the subject's heel land on completing the third jump. Upper limb movement during single leg horizontal hop testing is not restricted, although the subject are instructed to stick the landing on the last hop. On landing, the athlete will not shift the landing foot or to allow opposite foot to touch the ground for support. It is necessary to complete one step in one second. Athlete were allow to perform no more the 3 reps. A 30 second rest prior should be allowed between practice and test trail. A mean of distance should be calculated.

Y balance test

The Y balance test was created to assess dynamic balance, flexibility, and proprioception in order to anticipate injury. On a single leg, the Y balance test procedure was created to reach the anterior, posterior-lateral, and posterior-medial sides. The posterior lateral and posterior medial sides are perpendicular to the anterior side by 135 degrees.

Vertical jump

The vertical jump began with a 90-degree knee angle. Subjects executed a vertical jump by pushing upwards while keeping their legs straight throughout, preventing any downward movement. The counter-movement jump began with the patients standing upright and performing a quick downward movement to a knee angle of 90 degrees before pushing-off. The subjects were free to utilize their hands while jumping in the third test. Between each of the three trials, one minute of rest was permitted, with the top values for each leap being used in subsequent analyses.

Yo yo test

Use the cones to mark out two lines 20 meter apart from each other with 5 m as recovery phase. The players start with their foot behind one of the lines and begin running when instructed they continue running between the two lines, turning when signaled by the recorded beep. After each minute the pace gets quicker. The player must try to catch up with the pace within 2 more beeps. If the player is not reached to the line in time then the test is stopped.

40 m sprint test.

The test entails running a single maximum sprint over 40 meter while keeping track of your time. Begin by standing still with one foot in front of the other. On the starting line, the front foot must be. Before beginning, the runner should be completely still. Due to the time delay in the subject hearing the call, the person timing should stand at the finish line with one arm raised and 'ready' followed by a rapid sweep down their arm to start the subject (do not shout out 'go'). The tester should begin the stopwatch, which is held in the downward sweeping arm, as the arm sweeps down, and finish the stopwatch as their chest goes past the finish line.

Plyometric group intervention

exercises	Week 1 and 2	Week3 and 4	Week5 and6
3 hop to right the 3 hop to left (6 ground contact) 20 meter sprint	2 repetition Thursday and Friday	3 repetition Monday, Thursday and Friday	3 repetition Monday, Thursday and Friday
6 lateral 0.3 metre high hurdle jump (3 to left and 3 to right) 6 ground contacts followed by a 20 metre dash	2 repetition Thursday and Friday	3 repetition Monday, Thursday and Friday	3 repetition Monday, Thursday and Friday
6 horizontal jumps (three bell feet horizontal with the right leg, three bell feet horizontal with the left leg, six ground contact) followed by a 20-meter dash	2 repetition Thursday and Friday	3 repetition Monday, Thursday and Friday	3 repetition Monday, Thursday and Friday

Progression of the Strength-Training Protocol Group in Proprioceptive Neuromuscular Facilitation and Heel Raises for group 2

week	Resistance band	Set and repetition	activity	Set and repetition
Week1	Light blue (heavy)	3*10	Proprioceptive neuromuscular facilitation and heel raise	2*10
Week2	Light blue (heavy)	4*10	Proprioceptive neuromuscular facilitation and heel raise	2*10
Week3	dark blue super heavy	3*10	Proprioceptive neuromuscular facilitation and heel raise	3*10
Week4	Dark blue super heavy	3*10	Proprioceptive neuromuscular facilitation and heel raise	4*10
Week5	purple (ultra heavy)	3*10	Proprioceptive neuromuscular facilitation and heel raise	4*10
Week6	purple (ultra heavy)	4*10	Proprioceptive neuromuscular facilitation and heel raise	4*10

Data analysis

The data were analysed using SPSS version 23.0 and t-test for within the group analysis and unpaired t-test for between the group analysis. Values were expressed as mean ± standard deviation

A total of 69 cricketers were screened for eligibility out of which 9 did not meet the inclusion criteria for the study while 2

players decline to participate 58 subject remained and they assigned into 2 groups (plyometric group and strength training group) in above table mean±SD of age , height and BMI are mentioned

Demographic values of population

	parameter	Plyometric group	Strength group
mean	Age	18.89±0.03	18.89±0.03
Total no.	gender	Male=29	Male=29
Mean±SD	height	174.73±7.26	172.45±5.34
Mean±SD	BMI	21.49±3.25	20.11±3.12

Table1

outcome variables with in the group 1 (plyometric group)

variables	pre/post	Mean±S.D	T value	P value	DF
Triple hop	Pre post	371.58±17.49 410.62±19.16	2.32	0.0105*	56
Yo yo	Pre post	14.13± 1.26 15.03± 1.40	1.84	0.0041*	56
Vertical jump	Pre post	203.17±4.42 212.2±5.35	5.03	0.0021*	56
40m sprint	Pre post	11.33±3.6 9.35±1.73	5.05	0.0035*	56
Y balance	pre post	2786.17±238.71 2960.51±262.36	1.41	0.7612	56

Table2

Showing the comparison between pre and post values of plyometric groups with in the group for the triple hop, 40m sprint, vertical jump, yo yo and the balance of the player

outcome variables with in the group 2 (strength group)

variables	Pre/post	Mean±SD	T value	P value	DF
Triple hop	Pre post	363.48±6.79 400.44±7.77	2.64	2.35	56
Yo yo	Pre post	14.23±1.26 14.43±1.16	0.30	1.15	56

Vertical jump	Pre post	200.03±4 194.57±4.13	2.36	3.42	56
40m sprint	Pre post	12.62±3.022 12.95±3.027	1.85	2.76	56
Y balance	pre post	2698.44±283.36 2613.75±232.18	5.05	0.01*	56

Table3

Showing the comparison between pre and post values of strength training groups with in the group for the triple hop, 40m sprint, vertical jump, yo yo and the balance of the player

Outcome measure of pre data of between both group

Outcome parameter	Mean±S.D	T value	P value	DF
Triple hop	371.58±17.49 (plyometric) 363.48±6.79 (strength)	4.22	0.64	56
Yo yo	14.13± 1.26 (plyometric) 14.23±1.26 (strength)	1.6	0.38	56
Vertical jump	212.3±5 (plyometric) 200.03±4 (strength)	2.00	0.21	56
40m sprint	11.33±3.6 (plyometric) 12.62±3.022 (strength)	2.35	0.34	56
Y balance	2786.17±238.71(plyometric) 2698.44±283.36 (strength)	2.36	0.07	56

Table4

Showing the comparison between pre values of plyometric and strength training groups between the group for the triple hop, 40m sprint, vertical jump, yo yo and the balance of the player

Outcome measure of post data of between both group

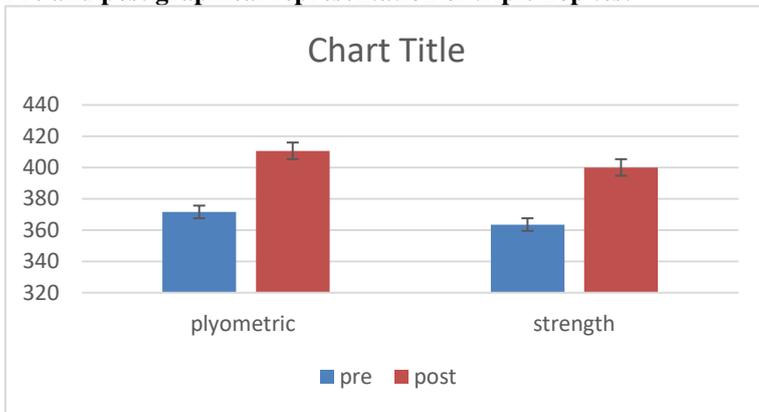
Outcome parameter	Mean±S.D	T value	P value	DF
Triple hop	371.58±17.49(plyometric) 363.48±6.79(strength)	4.22	0.0237*	56
Yo yo	14.13± 1.26(plyometric) 14.23±1.26(strength)	1.6	0.0241*	56
Vertical jump	212.3±5(plyometric) 200.03±4(strength)	2.00	0.001*	56
40m sprint	11.33±3.6(plyometric) 12.62±3.022(strength)	2.35	0.0001*	56

Y balance	2786.17±238.71 2698.44±283.36(strength)	2.36	0.1633	56
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Table5

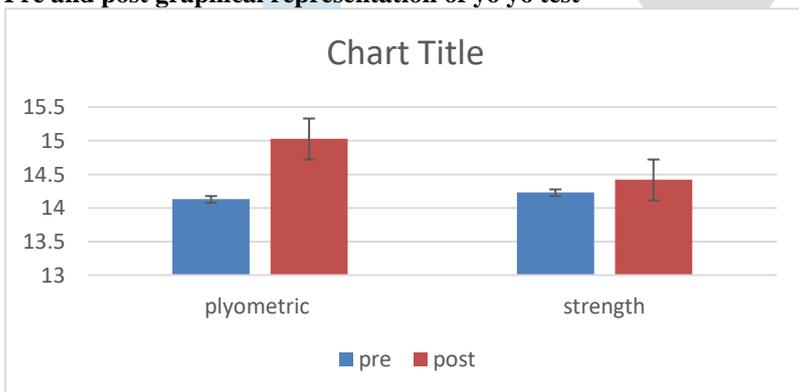
Showing the comparison between post values of plyometric and strength training groups between the group for the triple hop, 40m sprint, vertical jump, yo yo and the balance of the player

Pre and post graphical representation of triple hop test



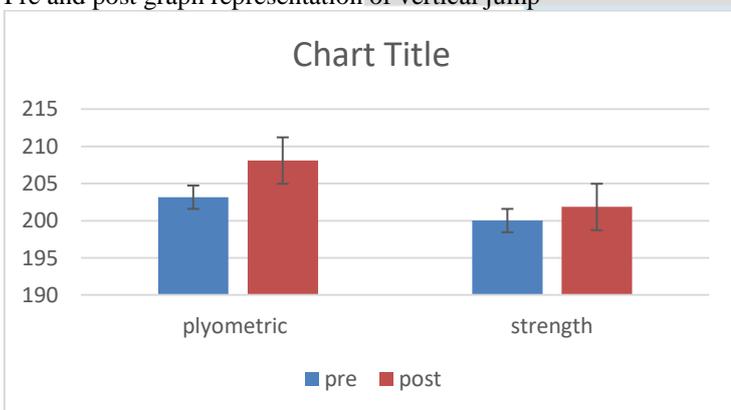
Graph1

Pre and post graphical representation of yo yo test



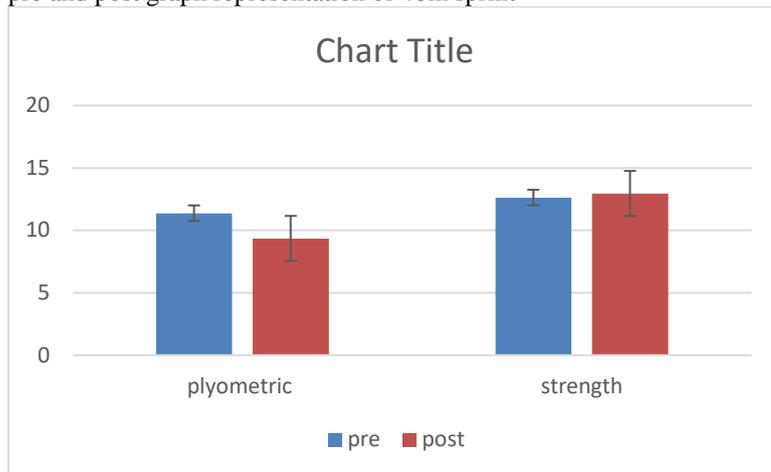
Graph2

Pre and post graph representation of vertical jump



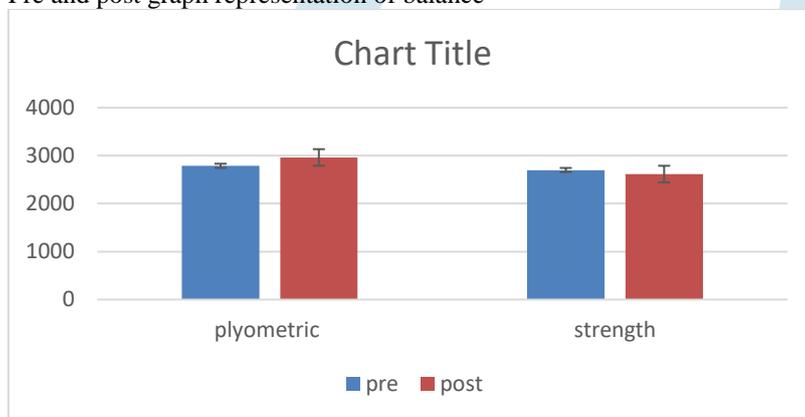
Graph3

pre and post graph representation of 40m sprint



Graph4

Pre and post graph representation of balance



Graph5

Result

The effectiveness of the plyometric group is elicited by comparing the pre test and post test values. In the plyometric group there is significant improvement in the plyometric group as compared with the strength training group in the plyometric group the four variables are improved out of five while in the strength training group the only one parameter is slightly improved which is balance. In the plyometric group the triple hop test ($p < 0.0237$), 40m sprint ($p < 0.0001$), vertical jump ($p < 0.001$) which is less than 0.05 so it is significant, yo yo test ($p < 0.0237$), balance ($p < 0.1633$).

Discussion

The primary outcome of the study was to see the significant effect of the plyometric training in the rehabilitation of fast bowlers with the ankle injury in u-19. The plyometric groups showed significant improvements in all outcome parameters except balance, while the strength training group shows slightly improvement into the balance³. Our current findings imply that plyometric training can boost this reaction, probably because this technique builds more strength. Our study also shows that the plyometric training improves the sprinting speed of the players which is measured by the 40m sprint test⁴. After the 6 week of study the plyometric group significantly improved into the 40m sprinting as compared with the strength training group⁴.

In the present study, the plyometric group uses the knee and hip joints more commonly to control ankle instability during landing than the strength training group during the vertical jump¹. In some previous study some authors suggested that reported that knee and hip flexion angles increased after plyometric training in a drop-landing task which is necessary in cricket to catch the ball to jump or to jump just prior to deliver the ball². And it is also seen into the vertical jump test. The increased knee flexion and hip flexion during the jump-landing task in vertical jump enabled the body to absorb joint forces more effectively and promote the mechanical advantage of soft tissue structures that provide joint stability. Decreased postural stability has been identified as a risk factor for ankle joint sprain⁵. It has consistently been shown in the literature that decreased dynamic postural stability is a feature of CAI⁵.

The another finding of this study is that the plyometric training also improved the muscular endurance of the cricketers which are very necessary for the fast bowlers to complete his over and maintain his body stamina⁶. Our study also suggests that the plyometric training also increases the endurance of the players. The muscular endurance of the cricketers is measured by the yo yo test. The yo yo test is the basic benchmark test to pass the criteria of the selection in any cricket team⁶.

The Y balance test was used to assess patients' dynamic balance and ability to maintain their center of gravity while completing a reach task with the opposite foot⁷. The detected increases in reach distance offered insight into the beneficial changes in dynamic

balance that can be attained from performing interventions used in this study and were supported by small to large effect sizes. These changes allow patients to be more functional during single-limb stance that is accompanied by a multi-planar reach task, which is commonly present during bowling.⁷ The results of the present study indicate that the 6-week dynamic plyometric training programme reduced the angle of ankle joint plantar flexion upon initial contact during jump landing, and the second initial ground contact during the drop vertical jump task.⁷ The 6-week plyometric training programme incorporated the principles of nervous system of body which modified itself to protect from injury and safe landing from jump from which the athlete required to perform numerous jump landing tasks⁵.

Conclusion

The plyometric training lasted six weeks. The protocol of under-19 male fast bowlers significantly improved all of the criteria in group 1 as compared to the strength training group (vertical jump, yo yo, triple hop, and 40m sprint). The balance is slightly better in group 2. We believe it was a smart idea to incorporate a 6-week plyometric training routine into the u-19 fast track programme. The plyometric exercise group improved their landing strategies by controlling ankle instability at landing shortly before releasing the ball by leveraging their knee and hip joints. This research implies that using plyometric exercises in ankle rehabilitation could increase stability and stress absorption, as well as help cricketers avoid injuries while fast bowling.

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