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Effectiveness of Plyometric Exercises to Improve Balance Among Football Players: A Randomised Control Trial

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ABSTRACT

Background: Football is a popular sport that relies on balance control for players to control movements, change direction, and maintain stability. Balance is crucial for players' running, jumping, tackling, and injury prevention. It involves maintaining the body's COG within its base of support, with the static balance being the most challenging. Dynamic balance requires maintaining equilibrium during transitions. Plyometrics is a form of resistance training that combines rapid eccentric and concentric contractions to produce fast forceful movements. It requires minimum basic strength levels and involves both the lower and upper extremities. Plyometrics has three phases: eccentric, amortization, and concentric. To perform plyometric exercises, perform one to two times per week on a firm, forgiving surface. If the technique deteriorates, the exercise should be stopped.
Study Design: Randomized Controlled Trial.
Outcome measures: SEBT, BBT
Methodology: A randomized control trial was done. Ethical clearance was taken from the committee. Samples were collected by the Random Number Generator sampling method. The details of the treatment were explained to the subjects and written consent was taken. In an 8-week intervention study, 30 participants in the age group of 18-25 years were studied. They were divided into 2 groups; group A received plyometrics balance training and group B received conservative treatment. Pre and post-treatment data was collected and analyzed using SPSS 22.0. Paired and unpaired t-tests were used to find out the significance of the treatment.
Result: A statistically significant improvement was seen in Group A compared to Group B in terms of balance.
Conclusion: In this study, Group A showed more statistically significant improvement in the score of SEBT in all 8 directions & improvement in BBT score that indicates plyometrics exercises are beneficial in terms of improving balance among young non-elite football players compared to Group B.

Keywords: Young non-elite football players, Plyometric training, SEBT, BBT,

INTRODUCTION

Football is one of the most popular sports in the world, with millions of people playing it at all levels. While most of the attention is directed towards elite players, the vast majority of football players are amateurs who play for fun, exercise, or in local competitions. However, even at this level, football players require a certain amount of skill that includes agility, endurance, balance, athleticism, and coordination, and one of the essential aspects of this is

balance.[1] Balance is crucial in football, as it allows players to control their movements, change direction quickly, and maintain stability when they are challenged by opponents or uneven terrain. As it is a contact sport and has always been a popular sport among both players and fans worldwide. However, the physical demands placed on athletes can result in a variety of health issues. One of the most significant concerns in football is balance, particularly in players who have suffered from various injuries. These balance issues can affect a player's performance and potentially lead to more severe injuries. So balance control is essential in football as it affects a player's ability to run, jump, tackle, and avoid injury during a game.

Balance can be static or dynamic and is generally defined as the capacity to keep the centre of gravity (COG) of the body within the base of support. The capacity to maintain the body in a state of static equilibrium or within its base of support is known as static balance.[2][3]

Because it calls for the capacity to maintain equilibrium during a change from a dynamic to a static state, dynamic balance is thought to be more difficult to achieve.[4] Effective integration of visual, vestibular, and proprioceptive inputs is necessary for both static and dynamic balance in order to generate an efferent response that controls the body within its base of support.[5][6]

Resistance training known as plyometrics combines rapid eccentric and rapid concentric muscle contractions to produce quick, forceful movements. It must be performed in conjunction with a resistance training program and requires minimum basic strength levels.[7]

Plyometrics involve both lower extremity (LE) and upper extremity (UE) as a part of functional movement patterns and skills when performing the sport. A lengthening movement (eccentric) is used, which is swiftly followed by a shortening movement (concentric), creating a stretch-shortening cycle (SSC).[8][9]

The plyometric exercise consists of three stages: The eccentric phase, also known as loading, the amortisation phase, also known as transition, and the concentric phase, also known as unloading, these are the three distinct phases that make up plyometric training.

There are several plyometric exercises available, such as hopping and bounding drills, jumps over hurdles and depth jumps. All of these exercises place a strong emphasis on spending as little time as possible on the ground. Plyometrics has a potential for injury and should be carefully supervised. It should only be performed one to two times per week and when the athlete is fresh. The surface must be firm, but forgiving, and the volume of work should be built up gradually. If the technique begins to deteriorate, the exercise should be stopped.[7]

Star Excursion Balance Test: The SEBT consists of a series of single-limb squats in which the limb not in the stance reaches as far as possible to touch a point along one of eight marked lines on the ground. The grid-like configuration of the lines radiates outward from a central point and is spaced 45 degrees apart. Each direction of reaching presents a unique set of difficulties and calls for a combination of sagittal, frontal, and transverse movements. The reaching directions are designated as anterior, anteromedial, anterolateral, medial, lateral, posterior, posteromedial, and posterolateral in relation to the stance limb. The objective of the task is for the person to establish a solid base of support on the stance limb in the centre of the testing grid and maintain it while extending their reach maximally in one of the predetermined directions.[21][22]

Standing on one leg, the participant extends the reaching limb as far as possible along each reaching line, lightly touches the line with the most distal portion of the reaching foot without shifting weight to or coming to rest on this foot of the reaching limb, and then returns the reaching limb to the starting position in the centre of the grid, resuming a

bilateral stance. The trial is not deemed successful if the person makes heavy or prolonged contact with the ground at the touch-down point, must maintain balance by making contact with the ground with the reaching foot, or lifts or shifts any portion of the stance limb's foot during the trial.[23] (ICC =0.84-0.92) [24]

Balance Board Test: - The Balance Board test measures agility and equilibrium. Participants in the test must stand on a platform and attempt to balance it for 30 seconds. The elderly need to be in good physical shape because poor balance can cause falls and injuries. Measurement of total body balance is the goal. Apparatus needed: A small, 2 cm wide beam that runs lengthwise down the middle of a wooden balance platform that is 50 by 50 by 1.5 cm in size. The platform's corners have been fitted with tiny stoppers to prevent the board from tilting more than 18 degrees.
The total amount of time that neither contact touches the floor is measured in counts (1 count equals 0.3 seconds; 100 counts equal 30). Therefore, a score of 100 is the maximum possible (for 30 seconds), and higher scores denote better performance. The need to acquire a special apparatus for this test is a drawback.[25]

NEED OF STUDY: Football is a difficult sport, so one should learn to balance well. Numerous research has been done on plyometric training to increase agility, speed, and balance in a variety of athletes, with a focus on professional football players. However, there is significantly less research on how to enhance balance in non-elite football players. Thus, the need of the study to determine the effect of plyometrics training to improve balance among young non-elite football players.

AIM AND OBJECTIVE OF THE STUDY:

AIM:

The study aims to analyse the effects of plyometric exercises to get improvement in balance among young football players.

OBJECTIVE:

The objective of the study is to find out the effect of plyometrics training on balance among non-elite football players.

HYPOTHESIS:

NULL HYPOTHESIS [H_0]:

There will be no statistically significant effect of plyometrics exercise on balance when added to non-elite football players.

ALTERNATIVE HYPOTHESIS [H_1]:

There will be a statistically significant effect of plyometrics exercise on balance when added to non-elite football players.

MATERIALS & METHODS

RESEARCH DESIGN: A Randomised Control Trial
SAMPLE DESIGN: Random Number Generator
STUDY POPULATION: Young non-elite football players
SAMPLE SIZE: 30 samples
Group A: Experimental Group (n-15) Plyometrics Exercise
Group B: Control Group (n-15) Conservative Treatment.

STUDY SETTING: Nootan College of Physiotherapy Sports OPD-5, Visnagar.
STUDY DURATION: 6 Months
TREATMENT DURATION: 8 weeks

INCLUSION CRITERIA:

Age: 18-25
Gender: Male
BMI (18.5-24.9kg/m^2)
Players who are willing to be part of study.

EXCLUSION CRITERIA:

Recent injury of lower limb
Lower extremity deformities

Any meniscal or ligamentous injury
Any arthritic changes in knee
Participants with recent fracture or dislocation
Participants with any neurological and psychological problems

OUTCOME MEASURES:
Star Excursion Balance Test [21][22][23][24]
Balance Board Test [25]
CTRI NO.: CTRI/2023/05/053070

SAMPLING PROCEDURE: The participants of age group between 18-25 years were assessed at Nootan College of Physiotherapy, Visnagar. The participants that fulfilled the inclusion criteria were informed and asked to be a part of the study. Those who agreed and signed a written consent form. After that demographic data of all the participants were recorded. The participants were divided into two groups i.e., group A and group B by random number generator method.

PROCEDURES OF DATA COLLECTION:
After Ethical clearance from the Institutional Ethical Committee, written consent from the Participants was taken. All Individuals completed a detailed assessment, baseline data of all the subjects were taken and pre-assessment was done with the Star Excursion Balance Test and Balance Board Test. The participants were divided into two groups i.e., Group A and Group B by Random Number Generator.
Group A (n-15) was treated with plyometric exercise program &Group B (n-15) was given conservative treatment. The treatment protocol consisted of 2 sessions of a plyometric exercise program/ week for 8 weeks.[16] The difference in the outcome measures after 8 weeks of treatment protocol was recorded.

TREATMENT PROTOCOL
GROUP A: PLYOMETRICS EXERCISE:

WEEK	EXERCISE	REPETITION
WEEK 1	• Standing long jump • Front cone hops • Forward – backward run*	6 reps × 2 set
WEEK 2	• Double leg horizontal jump • Side to side sprint* • Jump over low hurdles	6 reps × 3 set
WEEK 3	• Split squat • Lateral jump over hurdles • Side to side slide & hops • Lateral & horizontal jump	10 reps × 2 set
WEEK 4	• Cone hops with 180˚ turn • Vertical, lateral & horizontal jump • Single leg lateral jump	10 reps × 2set
WEEK 5	• Diagonal jump • Single leg vertical jump • Cone hops with 180˚ turn • Split squat jump	10 reps × 3 set
WEEK 6	• Double leg cone hops • Single leg lateral jump over hurdles • Diagonal jump over hurdles • Step, jump, down, up & sprint*	15 reps × 2 set
WEEK 7	• Diagonal jump over hurdles • Vertical, lateral & horizontal jump • Single leg horizontal jump • Box jump	15 reps × 3 set
WEEK 8	• Box jump • Single leg lateral & horizontal jump • Double leg diagonal cone hops • Split squat	14 reps × 4 set

GROUP B: CONSERVATIVE TREATMENT:

WEEK	EXERCISE	REPETITION
WEEK 1-2	Warm up Calf, hamstring & quadriceps stretching Hamstring curls (gradually increase in weight from 500gms)	• 5 min • 15-sec hold × 3 reps • 5 reps × 3 set
WEEK 3-4	Warm up Calf, hamstring & quadriceps stretching Hamstring curls (gradually increase in weight from 500gms)	• 7 min • 15-sec hold × 4 reps • 5 reps × 4 set
WEEK 5-6	Warm up Calf, hamstring & quadriceps stretching Hamstring curls (gradually increase in weight from 500gms)	• 10 min • 30-sec hold × 3 reps • 10 reps × 3 set
WEEK 7-8	Warm up Calf, hamstring & quadriceps stretching Hamstring curls (gradually increase in weight from 500gms)	• 20 min • 30-sec hold × 4 reps • 5 reps × 3 set

STATISTICAL ANALYSIS

All statistical analysis was done using SPSS 22.0 software for Windows. Descriptive analysis was obtained by mean and standard deviation. Intergroup comparison of pre-treatment BBT scores between group A and group B was done using an unpaired t-test. Intergroup comparison of post-treatment BBT scores between Group A and Group B was done using an unpaired t-test.

Intragroup comparison of pre & post-treatment BBT scores for group A was done using paired t-test. Intragroup comparison of pre & post-treatment BBT scores for group B was done using paired t-test.

Intergroup comparison of pre-treatment SEBT score for both the legs between group A and group B was done using an unpaired t-test. Intergroup comparison of post-treatment SEBT score for both the legs between group A and group B was done using an unpaired t-test.

Intragroup comparison of pre & post-treatment SEBT scores for both the legs for group A was done using paired t-test. Intragroup comparison of pre & post-treatment SEBT scores for both the legs for group B was done using paired t-test.

RESULT

Table 1: Subject demographics

Demographic Details		Group A	Group B
Age	Mean	20.733	20.600
	SD	±1.9445	±2.3543

Table 1 shows the mean age of subjects in Group A (20.733) and Group B (20.6). No statistically significant difference was found between the ages of the subjects in both groups, proving that the groups are homogenous in terms of age.

Table 2: Intergroup comparison of pre and Post treatment BBT

Outcome	Group A		Group B		t value	p value
	Mean	SD	Mean	SD		
BBT (PRE)	57.467	±4.688	56.87	±4.068	.3725	.712
BBT (POST)	91.2	±4.902	70.87	±3.204	13.447	< .0001

Table 2 shows the inter-group comparison of pre and post treatment BBT. The p-value is > 0.05. It shows that there is no statistically significant difference between the Groups A and B. Hence it proves that both groups are homogenous. P-value <0.05 in post group signifies statistically significant difference between Group and B, with a significant improvement in BBT score in Group A after treatment.

Table 3: Intra group comparison of pre and post-treatment BBT for group A and group B

Outcome	Pre-Treatment		Post-Treatment		t value	p value
	Mean	SD	Mean	SD		
BBT (Group A)	57.467	±4.688	91.2	±4.902	-21.669	.000
BBT (Group B)	56.87	±4.068	70.87	±3.204	-10.195	.000

Table 3 shows an intragroup comparison of pre- and post-treatment of BBT in group A where the p-value is <0.05. A statistically significant difference was found between the pre- and post-treatment of BBT, with a significant improvement in BBT score in Group A after treatment. P-value <0.05 signifies statistical difference between the pre- and post-treatment of BBT, with a significant improvement in BBT score in Group B after treatment.

Table 4: Intergroup comparison pretreatment Rt leg SEBT

SEBT (PRE)	Group A		Group B		t value	p value
	Mean	SD	Mean	SD		
Rt (A)	60.6	±4.85	60.2	±10.16	.1376	.5022
Rt (AM)	60.53	±4.67	62.13	±7.83	-.6798	.8915
Rt (M)	65.47	±4.66	63.8	±3.38	1.1211	.2718
Rt (PM)	67.47	±7.86	67.93	±9.84	-.1434	.8870
Rt (P)	60.33	±9.81	61.67	±3.37	-.4978	.6225
Rt (PL)	68.47	±8.97	69.67	±8.70	-.3720	.7127
Rt (L)	63.87	±6.42	62.53	±4.70	.6486	.5219
Rt (AL)	61.4	±8.12	60.6	±6.29	.3016	.7652

Table 4 shows the inter-group comparison of pretreatment Rt leg SEBT. The p-value is > 0.05 in all the directions. It shows that there is no statistically significant difference between Groups A and B. Hence it proves that both groups are homogenous.

Table 5: Intergroup comparison pretreatment Lt leg SEBT

SEBT (PRE)	Group A		Group B		t value	p value
	Mean	SD	Mean	SD		
Lt (A)	60.07	±7.17	61.4	±8.28	-.4716	.6408
Lt (AM)	65.2	±5.65	64.4	±4.44	.4315	.6694
Lt (M)	69	±8.17	69.73	±4.22	-.3090	.7596
Lt (PM)	70.4	±9.07	67.27	±11.02	.8505	.4023
Lt (P)	60.2	±8.84	60.67	±4.92	-.1786	.8595
Lt (PL)	68	±11.51	70	±10.64	-.4942	.6251
Lt (L)	63.8	±7.69	69.07	±4.57	-2.2792	.0305
Lt (AL)	70.8	±6.52	68.47	±7.40	.9168	.3671

Table 5 shows the inter-group comparison of pretreatment Lt leg SEBT. The p-value is > 0.05 in all the directions. It shows that there is no statistically significant difference between Groups A and B. Hence it proves that both groups are homogenous

DISCUSSION

The aim of the study was to improve balance in young non-elite football players. This study was carried out using plyometric exercises on the 30 subjects as per inclusion and exclusion criteria and divided into 2 groups. Plyometric exercises were given for

8 weeks to improve balance in young non-elite football players. The result of the present study demonstrated that improvement in balance after 8 weeks of plyometric exercises in group A but there was no significant improvement in balance in Group B. So, the null hypothesis is accepted and the experimental hypothesis is rejected here.

Balance and lower body strength are important in football players for several reasons. Firstly, balance is crucial for stability and agility on the field. It allows players to maintain control of their body while changing direction quickly, making cuts, or maneuvering around opponents. Good balance also helps in maintaining proper body position, which is essential for effective blocking, tackling, and evading tackles. Lower body strength, on the other hand, is vital for generating power and explosiveness in football players. Strong leg muscles, particularly the quadriceps, hamstrings, and glutes, enable players to accelerate quickly, jump higher, and change direction with speed and control. This strength is essential for actions such as sprinting, jumping, pushing or pulling opponents, and making explosive movements during gameplay. Furthermore, both balance and lower body strength contribute to injury prevention in football.

Good balance helps players maintain stability, reducing the risk of ankle sprains or losing control during tackles. Strong lower body muscles provide stability and support to the joints, reducing the likelihood of knee or ankle injuries. Additionally, lower body strength can help absorb impact forces and provide better shock absorption, reducing the risk of lower body injuries.

In summary, balance and lower body strength play crucial roles in the performance and safety of football players. They enhance agility, stability, power, and injury prevention, enabling players to excel in their respective positions and navigate the physical demands of the game. Plyometrics training is an important aspect of balance improvement. It involves explosive movements that activate the fast-twitch muscle fibres, which are responsible for generating quick and powerful contractions. By incorporating plyometric exercises into a training program, individuals can improve their ability to control their body movements and maintain balance.

The rapid and forceful contractions performed during plyometrics enhance neuromuscular coordination, proprioception, and reactive abilities. This type of training challenges the body's stability and coordination, which leads to improvements in balance. Plyometric exercises primarily target the lower body, including muscles such as the quadriceps, hamstrings, calves, and glutes. By strengthening these muscles, individuals can enhance their stability and control over their movements. This is particularly important for activities that require balance, such as walking on uneven surfaces, playing sports, or preventing falls.

Additionally, plyometrics training can improve the body's ability to absorb and dissipate forces, which is critical for maintaining balance. The rapid eccentric contractions involved in plyometrics help strengthen the tendons and connective tissues, making them more resilient to sudden changes in direction or weight shifts. Overall, incorporating plyometrics training into a balanced exercise routine can significantly improve balance and stability. By challenging the body's ability to generate and control explosive movements, individuals can enhance their neuromuscular coordination, strength, and proprioceptive abilities, leading to better balance and reduced risk of falls or injuries. In this study, subjects were divided into two groups (A & B). Group A was an interventional group in which plyometric exercises were given for 8 weeks to participants. Subjects in Group B were given conservative treatment. In this study, SEBT and BBT were used as outcome measures. Though a significant improvement was found after the treatment period in group A.

Group A showed greater improvement in SEBT and BBT scores. (p-value < 0.05). Thus this
study fails to reject the null hypothesis.

CONCLUSION

In this study, Group A showed more statistically significant improvement in the score of SEBT in all the 8 directions & improvement in BBT score that indicates plyometrics exercises are beneficial in terms of improving balance among young non-elite football players compared to Group B.

Declaration by Authors

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