Comparision of Two Different Plyometrics Training Protocols on Agility, Power & Sprint In Foot Ball Players" Randomized Control Trial

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Abstract-

Purpose

To compare the two different plyometric training protocols on agility,power, sprint in football player.

Subject & Method

30 subjects were selected, age of subjects was above 20 years and with experience of football for more than 5 years, were assigned in two groups, Group A which was average volume with progression protocol and group B which was low volume with tapering protocol, both the group performed 6 weeks of plyometric drill, which is jump from the height of 40 cm followed by horizontal jump as forward as possible, subjects in both group were adviced to minimize the ground contact time. Both pre and post exercise protocols evaluation was done

Result

On the basis of the three parameter i.e first: 20 meter run test in group A pre test value 4.57sec (±0.41) and group B pre test value 4.51sec (±0.47) mean post value of group A was 3.85sec(±0.34) and group B was 3.97(±0.34). Second – i.e. Power : group A right side was 5.49m (±0.26) and in group A left side was 5.21m (±0.34). The mean pre HOP in group B right side was 5.57m (±0.29) and in group B left side was 5.30m (±0.34) the mean post HOP in group A right side is 6.43m (±0.25) and in group A left side was 6.00m(±0.47) and in group B right side was 6.08m(±0.14) and in group B left side was 5.87m (±0.29). Third i.e.-Agility ,by Illinois test the mean pre Illinois test score in group A was 15.63sec (±0.74) and in group B was 15.65 sec (±0.48).The mean post Illinois in group A is 14.20sec (±0.65) and in group B is 14.43 sec (±0.51)

Conclusion

on the basis of the results in the present study it can be concluded that average volume with progression would be the ideal protocol to improve power, agility as well as the sprint performance in football players as compared to low volume with tapering protocol .

Keywords- Plyometrics training , Agility, Power and Sprint.

I. INTRODUCTION

Plyometric also known as jump training. The jumping movement is inherent in numerous sports activity such as basketball volleyball and aerobic dancing. Even running is repeated series of jump landing cycle. Therefore jump training should be used in the design and implementation of overall training programmed [1].

In late 1960 and early 1970 when eastern countries began to dominate power sports. Their training method become popular became the focus of attention, 1972 olympic article began to appear in training journal, the organization of this training method has been credited to legendary soviet jump coach yuriverhoshanski, who during late in 1960began to tie this method of hops and jump in to an organized training plan [1,2].

Plyometric training is popular among all the athlete involved in dynamic sports and plyometric exercises such as jumping hopping skipping and bounding, with purpose of heighten the excitability of the nervous system for improved reactive ability of the neuromuscular system. Therefore any type of exercise that choose the myotactic stretch reflex to produce more powerful response of contracting muscle is plyometric in nature. The goal is to increase dynamic muscular performance in muscle that undergoes a rapid elongation followed by an immediate shortening utilizing the elastic energy that stored during stretching phase [3].

Plyometric exercise has three distinct phases, All of these are involved in the stretch shortening cycle (SSC),the SSC incorporates the stored kinetic energy the muscle

develops in the series elastic component and the stretch reflex to produce muscular power, The three phases are eccentric or down amortization or transition phase, and concentric or up phase. Eccentric is when the agonist muscle is being stretched or loaded and the stimulation of the muscle spindles sends signals to the spinal cord. The series elastic component starts the process of storing kinetic energy obtained by the rate and magnitude of the stretch or load, the higher the magnitude and load, the more energy is stored. Amortization phase is the period between the down and up phase. Brief but strong isometric contraction is occurring in the muscle.1a fiber synapse with alpha motor neuron, concentric phase agonist muscle contract and utilizes the stored energy from eccentric phase and alpha motor neuron increases activation of the muscle [4,5,6].

Football game is most commonly played game in world, more than 208 countries play football .Football is associated various kind of injuries & if inappropriate training regimes are not followed the extent of injuries is further accelerated. It is most evolving game in India, young players are not only playing football but also taking part in competition, in football rapid movement such as acceleration and deceleration of the body, changes of direction as well as jumps are often performed is required at all level of training [7]. Football players require agility and power and sprint etc to perform in game, to enhance their performance, as well as returning to his her desired sports after injury. Injured athlete has enough range of motion, endurance, proprioception & strength, and power to perform at pre injury level, a way to increase balance, neuromuscular control, muscular strength and power is through the incorporation plyometric exercises in to the rehabilitation program. Football players use various technique, the most common technique used is the plyometric [8].

There is limited consensus regarding plyometric studies focusing on volume of training and progression of plyometrics and short term program [9] low impact [10]. Exercises are performed or intensity is not reported at all [10] in previous study[11] . Plyometric exercises with 30 sec duration or with 30 to 70 repetition were performed continuously with a possibility of improperly inducing high fatigue in participant, because of that there are different protocols used in plyometric in terms of volume of plyometric training. Hence on the basis of volume we found that there is mild moderate and high volume of protocol for plyometrics, some would suggest maximum of 60 to 70 foot contacts [7] to 90 foot contact (campo 2009) 120 foot contact [10]to some of the 270 to 640 foot contact [11].

This large variation in volume which are found in different protocol of the plyometrics, our aim is to compare the different volume of two protocol on sprint agility as well as power

II. REVIEW OF LITERATURE

Plyometric also known as jump training, The jumping movement is inherent in numerous sports activity such as basketball volleyball and aerobic dancing Therefore jump training should be used in the design and implementation of overall training programmed [1].

In late 1960 and early 1970 when eastern countries began to dominate power sports. Their training method become popular became the focus of attention. Plyometric training is popular among all the athlete involved in dynamic sports. Therefore any type of exercise that choose the myotactic stretch reflex to produce more powerful response of contracting muscle is plyometric in nature. The goal is to increase dynamic muscular performance in muscle that undergoes a rapid elongation followed by an immediate shortening utilizing the elastic energy that stored during stretching phase [3].

MichealG.miller et al (2006) selected average volume of the foot contacts for the training purpose they concluded that plyometric training improves agility, improvement can occur as early as 6 week of plyometric training which can be useful during the last season competition for athlete [10].

SoundraRajan et al (2010) concluded that there is statiscal significant differences in the increase of vertical jump in comparison to the control group.

Mark vaczi et al (2013) they asses strength and power and agility they concluded that short term plyometric training should be incorporated in the in season preparation of lower level player to improve specific performance [7].

Fatemehhossini et al (2012) concluded that no significant difference between three methods plyometric on muscle power is detected, therefore the plyometric training can use to improvement in muscles power in female student.

Jose manuel et al (2010) concluded that complex and contrast training is an adequate training strategy to develop soccer player's muscle power and speed.

Eduardo saez de villareal (2012) this study done meta-analysis on effects of plyometric on sprint performance they concluded that horizontal jumping with volume of 80 to 120

foot contact is the adequate method of increasing the performance of the sprint .

III. HYPOTHESIS

NULL HYPOTHESIS:

Protocol A is as effective as protocol B in improving the power ,agility and sprint.

ALTERNATE HYPOTHESIS:

There are differences in effectiveness of protocol A (i.e. progression + average volume) and protocol B in terms of power, agility and sprint

IV. AIM AND OBJECTIVES

AIM

To Compare between two different protocol of the plyometric training in improving power, agility and sprint performance.

OBJECTIVES

Compare 2 Protocol of plyometrics on

1. Agility
2. Sprint
3. Power.

V. MATERIAL AND METHODS

DESIGN OF THE STUDY

Randomized control trial

PLACE OF STUDY:

Integral University Campus and Sports college of Lucknow.

STUDY POPULATION:

Integral University Campus and Sports College of Lucknow& K D Singh Babu Stadium.

SAMPLE SIZE:

30 subjects, 15 in each group

STUDY DURATION:

6 months.

SELECTION CRITERIA

Inclusion criteria:

1. Age between 20 to 30 years
2. Both male and female
3. Professional football players for more than 5 years.

Exclusion criteria:

- Recent injury to the lower extremity and back.
- Incomplete recovery from fracture of lower limb.
- Incomplete ROM of the lower extremity.
- Inadequate flexibility of the lower limb.
- Inadequate strength on MMT.
- Congenital deformity of the lower extremity and back.

VARIABLES

DEPENDENT VARIABLE:

1. Agility- in seconds by Illinois test. [12]
2. Power- by Triple hop distance test.[13]
3. Sprint- 20 meter run test.

INDEPENDENT VARIABLE:

- Active Warm-Up
- Plyometric protocol A(progression)
- Plyometric protocol B(tapering)

MATERIAL

- Marker
- Scale
- Cones
- goniometry
- chalk
- rope
- Inch tape

PROCEDURE

All the subject were selected on above mentioned inclusion and exclusion criteria, subject were assigned in each group prior to participation , athletes were explained about the study and informed consent was given individually signed by athletes. Prior to study, pretest examination was

done, baseline data was taken such as weight, height, agility, power and sprint.

After taking inform consent, all subjects were requested not to change their exercise habits during the course of the study. Both Plyometric training groups participated in a 6 week training protocol design for lower extremity. All subjects were instructed not to start any lower extremity strengthening exercise during 6 weeks of period but can perform routine activities of daily living. Procedure and guidelines were explained orally and also in the written form.
Both the group consisted of two test sessions i.e pre and post plyometric exercise test and a plyometric training intervention. Pre exercise test was performed three days before the beginning of training and included tests to evaluate lower extremity power strength and agility and BMI. Six weeks long training program will be applied, followed by post exercise test,3 days after last training day.

All the training session begins with standardized warm-up protocol. For training each participants warmed up with their usual routine. This comprise 8 to 10 mint of running drills in to different direction followed by stretching of the lower extremity muscles followed by plyometric drill were executed immediately after the warm up.

6 weeks plyometric program were develop using two training session per week in both the group with depth jump. Group A subjects were perform warm-up protocol as mention above followed by plyometric training. Height of depth jump box was fixed to 40 cm, training intensity was increased from 80 foot contact to 120 foot contact by the end of training [10].Group B perform exercise such as active warm up as similar as group A followed by training that is first 2 week were a preparatory phase followed by three more week with increased volume, and one week with reduce volume to taper. Both the group were instructed to minimize ground contact time while maximize height.

In Group B will perform exercise twice a week with height of 55cm with protocol of $w_1$to w $_2$ 4 set with 5 repetition and from w_3 to week $_5$ 6 set with 5 repetition and on 6 week 2 set with 5 repetition,

In Group B performed warm-up same as group A followed by training i.e first two weeks was a preparatory phase twice a week with height of 40 cm with protocol of $w_1$to week 2 4 set with 5 repetition and from week 3to week 5, 6 set with 5 repetition and on 6 week 2 set with 5 repetition [7].

Group A will perform exercise twice a week with height of 40 cm with protocol of week 1 to week 2, 4 set with 5 repetition and from week 3to week 5, 6 set with 5 repetition and on 6th week 2 set with 5 repetition,

Group B subjects will perform same warm-up protocol followed by plyometric training height of depth jump box will be fixed to 40 cm but training intensity is increased from 80 foot contact to 120 foot contact by the end of training. Both the group will be instructed to minimize ground contact time while maximize horizontal distance. Depth jump were performed with a person standing on a 40 cm of the box. The subject were instructed to jump from the box and minimize the ground contact time followed by as maximum as possible covered horizontal distance.

Agility: It has been suggested that Plyometric training improves sport specific agility in sports where sudden change of movement direction are required. The Illinois agility test was used to measure agility during sprints including direction changes without stopping and running at different angles participant were perform three trail of the agility test followed by 10 mint of recovery period between test or analysis The mean of retrial consider best of the two trail were be consider for analysis [12].

Power: Triple hop distance test is valid predictor of lower limb strength. We fixed standard measuring tape on the ground perpendicular to starting line. Dominant leg with a great toe on starting line to the point where the heel struck the ground upon completing the third hop, arm swing allowed, all the participant were allowed 1 to 3 practice trials. On each leg and then completed 3 test trials. Practice trial time were given to allow the athlete to familiarize themselves with test. Test trial were repeated if the participant was unable to complete a triple hope without losing balance and contacting the ground with opposite leg. Maximum distance cover in 3 trial was recorded in meter and mean of all three trials was consider for the analysis [13].

Sprint: The 20 meter run test was used to assess sprint performance of the subjects. The 20 meter distance was measured from the starting line. The subjects were instructed to be ready at the starting line and followed the instruction from starting line and follow the instruction of the evaluator. Subjects have to complete 20 meter distance in as short time as possible on the call of start.3 minute of recovery period was given between each trial. The mean of each trial was consider for the analysis [14].

VI. DATA ANALYSIS

The frequency and percentage would be calculated for qualitative data means (+_ SD) would be calculated for continuous data. Paired unpaired t- test will be used to

compare the continous variable between two groups, while one way ANOVA will be used for more than two groups.

P value less than 0.05 will be taken as a criteria for rejecting null hypothesis.

VII. RESULT

Table 1: Personal Characteristics of Study subjects

	Group A	Group B	Significance
Age	24.47±2.64	24.47±2.56	t=0.00,p=1.00
Experience	9.73±3.51	9.47±1.88	t=0.25,p=0.79
BMI	21.86±0.55	21.78±0.37	t=0.45,0.65

Table 1 shows the Personal Characteristics of Study subjects according to age, experience and BMI. The result shows that the mean age of study subjects in group A is 24.47 years (±2.64) and in group B is 24.47 years (±2.56). The t test shows that the mean age of study subjects is almost same in both groups (t=0.00,p=1.00). The mean experience of study subjects in group A is 9.73 years (±3.51) and in group B is 9.47 years (±1.88). The t test shows that there is association between group A and group B.the mean BMI of study subjects in group A is 21.86kg/m^2(±0.55) and in group B is 21.78kg/m^2(±0.37).the t test shows that the mean BMI of study subjects is significantly different (t=0.45,0.65)

Table 2 : Dominance of Study Subjects

C	Group A	Group B
L	1	3
R	14	12
Significance	Chi Square =1.15,p=0.28	

Table 2 shows the dominance of study subjects. Result shows that the distribution of study subjects according to dominance in group A,1 subject is left dominance and 14 are right dominance. in group B 3 are left dominance and 12 are right dominance. The chi square test shows that there is no association between dominance& study groups (Chi Square =1.15,p=0.28).

Table 3: Effect of intervention on 20 meter run test

20 meter run test	Group A	Group B	**Significance**
Pre	4.57±0.41	4.51±0.47	t=0.34,p=0.73
Post	3.85±0.34	3.97±0.34	t=-1.03,p=0.31
Significance	t=9.63,p=0.000	t=9.48,p=0.000	

Table 3 shows the effect of 20 meter run test. Result shows that the mean pre 20 meter run test in group A is 4.57sec (±0.41) and in group B is 4.51sec (±0.47). the mean post intervention in group A is 3.85sec(±0.34) and in group B is 3.97(±0.34).The pre post t- test shows that there is a highly significance difference between pre post 20 meter run test i.e. time duration for 20 meter run has been decrease significantly in group A (t=9.63,p=0.000).More similarly, time duration also decreases in pre post test in group B (t=9.48,p=0.000).Overall results show that, effect of intervention is better in Group A.

Table 4: Effect of intervention on triple HOP distance test

HOP	**Group A**		**Group B**	
	Right	**Left**	**Right**	**Left**
Pre	5.49±0.26	5.21±0.34	5.57±0.29	5.30±0.34
Post	6.43±0.25	6.00±0.47	6.08±0.14	5.87±0.29
	t=2.16,p=0.048	t=3.11,p=0.008	t=-7.77,p=0.000	t=-14.28,p=0.000

Table 4 shows the Effect of intervention on HOP test. Result shows that the mean pre HOP in group A right is 5.49m (±0.26) and in group A left 5.21m (±0.34). The mean pre HOP in group B right side is 5.57m (±0.29) and in group B left side is 5.30m (±0.34). Result shows that the mean post HOP in group A right side is 6.43m (±0.25) and in group A left side is 6.00m(±0.47) and in group B right side is 6.08m(±0.14) and in group B left side is 5.87m (±0.29).The t test shows that pre post t- test shows that there is a highly significance difference between pre post intervention triple hop distance test i-e distance of hop has been increased significantly in group A on both side i-e left and right side rt(t=2.16,p=0.048) left (t=3.11,p=0.008). More similarly distance is also increased pre post test on both side i-e right and left side in group B right (t=-7.77,p=0.000) lft (t=-14.28,p=0.000).Overall results show that, effect of intervention is better in Group A than group B.

Table 5: Effect of intervention on Illinois test

Illinois	Group A	Group B	**Significance**
Pre	15.63±0.74	15.65±0.48	t=0.08,p=0.93
Post	14.20±0.65	14.43±0.51	t=1.04,p=0.30
Significance	t=1.69,p=0.000	t=11.88,p=0.000	

Table 5 shows the Effect of intervention on Illinois test. Result shows that the mean pre Illinois in group A is 15.63sec (±0.74) and in group B is 15.65 sec (±0.48).The mean post Illinois in group A is 14.20sec (±0.65) and in group B is 14.43 sec (±0.51). The t test shows that the mean pre Illinois is same in both groups (t=0.08,p=0.93).Where as the

mean post Illinois in group A shows maximum improvement i.e statistically significant (t=1.69,p=0.000) than group B (t=11.88,p=0.000)

VIII. DISCUSSION

Aim of the study to compare between two protocol ,which were differing upon the volume of training and foot contacts ,it was found that both the different volumes of training from two different protocols were effective in improving the agility, power and sprint in the football players. The protocol A i.e moderate volume protocol (progression) which ranged from 80 to 120 foot contact , showed significant improvement in agility, power and sprint.

Initial discussion regarding changes with respect to power from two protocols:

Improvement in power in both groups was observed on the basis of 2 theory behind power,1) neurophysiologic model 2)mechanical model that explain that plyometric can improve the muscles' ability to generate explosive power [15].
Neurophysiological model involves the use of kinetic energy the muscles produce when placed on a quick stretch this quick stretch, muscle undergoes is called the stretch reflex, it occurs by stimulation of muscle spindles, that are located in parallel with muscle fibers during stretch shortening cycle muscle undergoes quick stretch, muscle spinal cord via Ia fibers. Which synapse with alpha motor neuron, causing increased tension in the muscle if this tension is not utilized quickly (0.15sec) in a concentric action , this increase in muscle tension is lost and dose not help with force production [15].
Mechanical model involves the musculo tendinious junctions which increases the muscle ability to produce the force after quick stretch [8]. Contractile component (cc), series elastic component (SEC), parallel elastic component (PEC), all interact to produce a force output. Although CC is usually the focal point of motor control, SEC and PEC also play an important role in providing stability and integrity to individual fiber during when muscle is lengthen. During this lengthening process energy is stored within the musculature in the form of kinetic energy. When the muscle contract in a concentric fashion most of the force that is produced comes from muscle fiber filament sliding past one another. Force is registered externally by being transferred through SEC. When eccentric contraction occur, the muscle lengthen like spring with this lengthening SEC is also stretched and allowed to contribute to all overall force production. therefore the total force production is the sum of force produced by CC and stretching of SEC. When stretch is applied potential energy is stored and applied as it returns to original length when the stretch is released. Significant increases in concentric muscle force production have been documented when immediately preceded by eccentric contraction [16,17,18].This increase might be partly due to storage of elastic energy, because muscles are able to use the force produced by SEC. When muscle contracts in concentric manner, elastic energy stored in SEC can be recovered and use to augment the shortening contraction. The ability to use this stored elastic energy is affected by three variables (time, magnitude of stretch, velocity of stretch) [19]. Concentric contraction can be magnified only if the preceeding eccentric contraction is of short range and performed quickly without delay [16,17,18].
In group A power increased more that means triple hop distance covered was more in group A population than group B probable explanation for that could be the difference in training volume of training, as there is huge difference between the volume in both group.

Agility:

Our study also focuses on effect of two different protocol on agility. Both the groups showed significant improvement in the Illinois agility test but group A showed more improvement in Illinois agility test than group B.

Agility training is thought to be a re-enforcement of motor programming through neuromuscular conditioning and neural adaptation of muscle spindles, golgi-tendon organ and joint proprioceptors [20].

Plyometric training help to reduce the time required in completing agility test measures because of either better motor recruitment or neural adaptation. Can be due to enhanced motor unit recruitment pattern[10].Neural adaptation can occur when athlete respond or react as result of improved coordination between the CNS signal and proprioception (20).In the Muscle increased proprioception could be one reason for enhanced agility in plyometric training.[7]

Increase in power and efficiency in plyometric may increase the agility training objective (stone bryant et al 1984). Improvement in magnitude is depending on training status or age of participant [7]. As there was no significant differences between age of both the group A and group B reason for improvement would be due to training volume protocol.
Sprint:

Training with explosive pre stretch of muscles can improve the neural efficiency. plyometric training can promote changes within the neuromuscular system that allow individual to have better control of contracting muscle and its synergist yielding greater net force even in the absence of morphological adaptation of muscle. This neural adaptation

can increase performance by enhancing nervous system to become more automatic [1].

Plyometric training induce beneficial neuromuscular adaptation in hip adductors muscle that may assist in knee stability, adductor muscles pre-activation and adductor and abductor co-activation both increases in plyometric training.[11]

Previous study support the use of Plyometric training to enhance dynamic restraint and functional stability at knee joint, sprint speed increased in both group of study but slightly more improvement has been noticed in group A population because of difference in the training volume, increased lower limb power could also be one possible explanation for the increased level of sprint performance [11].

Higher improvement in sprint performance may be because of training specificity. Training programmed that incorporate more horizontal acceleration may improve sprint times. Volume of training more than 80 foot contact is the best volume for improving sprint of the athlete [21] that's why more improvement is found in group A than group B population.
Finding of our study are in accordance with from various researches from past, our study further support finding that specific training volume is responsible for changing agility power and sprint, less volume of training would be possible reason for relatively less improvement.

LIMITATIONS

- Sample size was small
- Study lacks in giving the information regarding duration of lasting effects of training.
- Duration of study was less
- Specific tools for evaluation were not used .

IX. FUTURE STUDY

- Similar Study should be carried out with a larger sample size.
- Similar studies can be performed using Isokinetic machine and force end plates should be for the assessment of strength and power.
- Study should be done with follow up to identify and understand lasting effects of training
- Duration of training should be large to understand effect long duration on the plyometric training.
- Future studies can include both female and male population.

X. CONCLUSION

From the analysis of present study it can be concluded that when plyometric program incorporating moderate volume with progression in foot contacts are given the agility, power & sprint in football player was enhanced to higher extent when compared to plyometric low volume with tapering in foot contacts. The findings of this study will be judgmental for selection of plyometric programs in future for training and rehabilitation.

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