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Effect of Unilateral and Bilateral Resistance and Plyometric Training on Skill Performance of Soccer Players

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Abstract

The intention of this study was to examine the effectiveness of unilateral and bilateral resistance and plyometric training on skill performance of Soccer players. The study was delimited to the soccer players of age between eighteen and twenty one years and they were selected from the Mohammed Sathak AJ Engineering College, Siruseri, Chennai and Hindustan College of Arts and Science, Padur, Chennai. Participants were randomly assigned to four different training groups (15 in each group). Group-I performed Unilateral Resistance Training [URT], Group-II performed Unilateral polymeric training [UPT], group-III performed Bilateral Resistance and plyometric Training [BRPT] and group-IV acted as control [CG]. The experimental groups trained at the same time of day in the morning session, three days a week for 12 weeks, throughout the study. The soccer skill performance was assessed by MCDonald Soccer Test. The data collected from the experimental groups on selected dependent variable was statistically analyzed by paired 't' test and analysis of covariance (ANCOVA). The Scheffe's post hoc test was also applied. Further, percentage of changes was calculated to find out the chances in selected dependent variables due to the impact of experimental treatment. In all the cases the level of confidence was fixed at 0.05 level for significance. Due to URT, UPT as well as bilateral training the soccer player's skill performance was greatly improved. Though, UPT was much better than bilateral training whereas insignificant differences were found between UPT and URT groups and also between URT and bilateral training.

Keywords: Unilateral and bilateral resistance and Plyometric training, skill performance, Soccer players.

Introduction

Owing to a single base of support, unilateral resistance exercises are considered sport specific (Jones et al., 2012; McCurdy & Conner, 2003). The unstable nature has demonstrated altered neuromuscular activation levels in gluteal, hamstring, and quadricep muscle groups compared with bilateral movements (McCurdy et al., 2010; DeForest, Cantrell & Schilling, 2014). Several lower-limb musculotendinous injuries are attributed to neuromuscular deficits, which may be rectified by targeted unilateral training (Tyler et al., 2006). Coupled with the resemblance of sporting movements, unilateral exercises are recommended for rehabilitation requiring enhanced neuromuscular coordination (Beutler et al., 2002). However, the unstable base may also reduce the magnitude of external load required for strength development and subsequent improvement in sports performance in trained individuals (Behm, Anderson &Curnew, 2002).

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Studies investigating the effect of unilateral vs. bilateral resistance training have reported similar strength outcomes, inferring equal benefit using either of the two (McCurdy et al., 2010; Speirs et al., 2015). Investigating bilateral and unilateral resistance training involves several practical limitations making sound methodological designs challenging and findings difficult to apply. These include the training age of subjects, inadequate familiarization and training period duration, unadjusted differences in pre-training performance, insufficient resistance training stimulus, and supplemental exercise prescription (Speirs et al., 2015; Fisher &Wallin, 2014; Gonzalo-Skok et al., 2016). For example, although improvements in unilateral basketball performance have reported the adolescent age of subjects (average age 17 years), this may have little application to mature athletes (Gonzalo-Skok et al., 2016).

Plyometric exercises are commonly used in soccer training because they can be easily performed and combined with other sport-specific explosive activities, while they do not require a lot of space, time and equipment (Faigenbaum et al., 2007; Michailidis et al., 2013). Competitive soccer performance requires high levels of agility, power and efficient usage of the stretch-

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shortening cycle, during short-duration maximal efforts (Thomas et al., 2009; Ramirez-Campillo et al., 2018; Ribeiro et al., 2019). In high-level soccer, a research study showed that elite players selected for the national team, were superior in the above variables than the non-selected players (Ramirez-Campillo et al., 2015). Plyometric exercises improve these physical abilities and consequently could fit into soccer training organization to improve performance in movements such as changes of direction, accelerations and decelerations (Michailidis et al., 2013).

Soccer is the most watched and played sport in the world, and it also one of the most diverse sports in terms of energy systems, performance markers, and variety of movements used. Specifically, the sport of soccer requires various degrees of aerobic and anaerobic energy systems depending on the game-plan, opponent, and what position the athlete plays. This study aimed to examine how a typical training program is developed and the type of strength and power development training programs that are currently implemented at the elite level. Furthermore, this study will expand on current training protocols and evaluate the effects of a potentially more effective training method (unilateral and bilateral resistance and plyometric training) to improve fitness elements and striking variables that can potentially translate to improved skill performance on to the soccer field.

Methodology

Subjects and variable

The study was delimited to the soccer players of age between eighteen and twenty one years and they were selected from the Mohammed Sathak AJ Engineering College, Siruseri, Chennai and Hindustan College of Arts and Science, Padur, Chennai. Participants were randomly assigned to four different training groups (15 in each group). Group-I performed Unilateral Resistance Training [URT], Group-II performed Unilateral plyometric training[UPT], group-III performed Bilateral Resistance and plyometric Training [BRT] and group-IV [CG] acted as control. The selected subjects were medically examined by a qualified physician and certified that they were medically and physically fit enough to undergo the training programme. To measure general soccer ability, though mainly trapping and passing skills, MCDonald Soccer Test was utilized.

Training Programme

Adequate warm up was given to the subjects prior to the unilateral and bilateral resistance and plyometric training. The experimental groups trained at the same time of day in the morning session, three days a week for 12 weeks, throughout the study. The experimental group-I performed unilateral resistance training (URT), group-II performed unilateral plyometric training (UPT), group-III performed bilateral resistance and plyometric training (BRPT) and group-IV was control (CG). The unilateral and bilateral resistance and plyometric training groups participated in a 12-week training program performing a variety of exercises designed for the upper and lower extremity.

Unilateral and BilateralResistanceTraining Exercises

After familiarization and baseline testing, the players participated in a 12-week unilateral and bilateral resistance training program with three training sessions per week. The resistance training program was a total body workout consisting of 3 sets of 4-12 repetitions on 6 exercises that trained all the major muscle groups. The load was fixed for the experimental groups based on one repetition maximum (1 RM) of each participant in all the selected resistance exercises. Training volume for the unilateral resistance (URT) and bilateral resistance (BRT) groups was equalized, with the BRT performing all exercises with support on both legs, while the URT group performed 50% of the exercises on each leg separately.The intensity of exercise performed for each exercise was progressively increased once in two weeks.The rest interval of 1:1between exercises and 1:3minutes between sets was given.

Unilateral and BilateralPlyometric Training Intervention

The participants in all groups trained for 12 consecutive weekswith three training sessions per week. During this 12-week program, the type of plyometric drills increased progressively, in terms of number of foot conducts, as well as the level of difficulty. In addition, the volume of the plyometric training sessions increased progressively by increasing number of foot-contacts. During all training sessions, a standardized warm-up was performed (3 min of easy running, dynamic stretching & soccer drills). Training volume for the unilateral plyometric (UPT) and bilateral plyometric (BPT) groups was equalized, with the BPT performing all jumps with support on both legs, while the UPT group performed 50% of the jumps on each leg separately. Each plyometric training session performed with maximum effort. Training volume ranged from 90 foot contacts to 140 foot contacts per session. Ample recovery was given based on work rest ratio between exercises (1:1), sets (1:3) and sessions (one day).

Statistical Technique

The data collected from the experimental groups on selected dependent variable was statistically analyzed by paired ‘t’ test to find out the significant differences if any between the pre and post test. Further, percentage of changes was calculated to find out the chances in selected dependent variable due to the impact of experimental treatment.

In order to nullify the initial mean differences the data collected from the four groups prior to and post experimentation on selected dependent variable were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance

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(ANCOVA). The pre test means of the selected dependent variables was used as a covariate. Since four groups were involved, whenever the obtained 'F' ratio value was found to be significant for adjusted post test means, the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any. In all the cases the level of confidence was fixed at 0.05 level for significance.

Result

The assessed pre and post test general soccer ability scores of URT, UPT, BT & Control group's are analyzed as in table -I.

Table 1. *Paired't' Test and % of Changes on Skill Performance of URT, UPT, BT & Control groups*

Group	Test	N	Mean	SD	DM	't' - ratio	%
Unilateral Resistance Training	Pre	15	27.73	1.83	2.93	8.51*	10.57
	Post	15	30.66	1.34			
Unilateral Plyometric Training	Pre	15	28.00	1.77	3.66	7.41*	10.94
	Post	15	31.66	1.95			
Bilateral Training	Pre	15	28.20	1.65	1.53	5.60	6.05
	Post	15	29.73	1.75			
Control	Pre	15	27.93	1.83	0.06	0.05	0.23
	Post	15	27.86	4.59			

*Table value for df14 is 2.15(*significant)*

The assessed pre and post test skill performance values of three training (URT, UPT & BT) groups differ noticeably since the 't' values of URT (8.51), UPT (7.41) as well as bilateral training (BT=5.60) groups were greater than the table value (df14=2.15).Following 12 weeks of URT, UPT and BT treatment, soccer player's skill performance (URT=10.57%, UPT=10.94% andBT=6.05%), enhanced greatly.

The chosen soccer player's skill performance of URT, UPT and BT groups were analyzed through ANCOVA statistics, and put on view intable–II.

Table 2. ANCOVA Statistics Output on Skill Performance ofURT, UPT, BT& Control Groups

	Unilateral Resistance Training	Unilateral Plyometric Training	Bilateral Training	Control	SoV	SS	df	MS	'F' ratio
Adjusted Mean	30.76	31.65	29.63	27.88	B	119.12	3	39.70	25.91*
					W	84.27	55	1.53	

*(Table value for df3&55 is 2.77)*Significant (.05 level)*

The ANCOVA statistics result established that the adjusted final means (URT=30.76, UPT= 31.65, BT=29.63 & CG=27.88) on soccer skill performance of all (URT, UPT, BT &Control**)** chosen groups differs from one another, because the derived adjusted final mean's 'F' value (25.91) is superior to requisite value (*df 3 & 55* =2.77).

As the URT, UPT, BT & Control group's adjusted final means 'F' value (F= 25.91) is significant, further statistics **Scheffe's Test**was calculated as in table number-III.

ISSN: 2349 – 4891

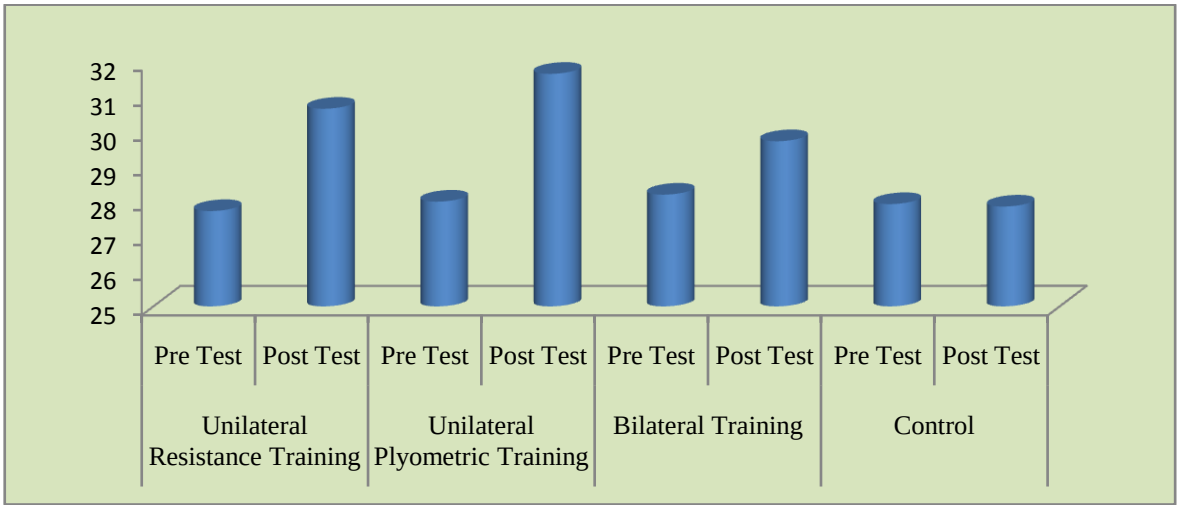
Table 3. Scheffe's Test Outcome on Soccer Skill Performance ofURT, UPT, BT & Control Groups

Variable	Unilateral Resistance Training	Unilateral Plyometric Training	Bilateral Training	Control	MD	CI
Soccer Skill Performance	30.76	31.65			0.89	1.59
	30.76		29.63		1.13	1.59
	30.76			27.88	2.88*	1.59
		31.65	29.63		2.02*	1.59
		31.65		27.88	3.77*	1.59
			29.63	27.88	1.75*	1.59

**Significant (.05)*

It (Scheffe's Test) proved that due to URT (2.88), UPT (3.77) as well as bilateral training (1.75) the soccer skill performance was greatly improved. Though, UPT was much better than bilateral training (MD=2.02) since the mean differences (2.88, 2.02, 3.77 & 1.75) are higher than CI value (1.59). Whereas insignificant differences were found between UPT and URT groups (CI>0.89) and also between URT and bilateral training(CI>1.13). Chosen URT, UPT, BT & Control group's soccer skill performance are graphically displayed in diagram-I.

Figure I. Figure Showing Soccer Skill Performance of URT, UPT, BT& ControlGroups



Discussion

Resultproved significant improvement in soccer skill performance due to unilateral and bilateral resistance and plyometric training. Many studies have examined the possible interference of unilateral and bilateral resistance and plyometric training on soccer skill performance.During the past 2 decades, soccer is becoming progressively more athletic, and the capacity of soccer players to produce varied forceful and explosive actions, such as sprinting, jumping, tackling, kicking, turning, and changing pace, has become crucial in many game situations (Castagna et al., 2003; Reilly, Bangsbo& Franks, 2000). In modern football approach, these considerations are increasingly essential to optimal performance not only in adults but also in young players because it has been previously reported in notational game analyses (Castagna et al., 2003; Stroyer, Hansen &Klausen, 2004). For instance, high-speed sprinting contributes up to 3% of the total distance covered in children's games (Castagna et al., 2003) and most crucial moments of the game, such as winning ball possession, scoring, or conceding goals, depend on it (Reilly, Bangsbo& Franks, 2000). Such explosive actions are integral elements for success in soccer and have to be trained independently from aerobic power with an optimal training stimulus (Helgerud et al., 2001).

Soccer requires many single leg, or unilateral actions, continuously over an extended period of time such as sprinting, cutting, jumping, kicking, turning, and bracing against a defender. More specifically, when a player dribbles, passes, orshoots the ball, one leg is dominant to forcefully move the ball and the other leg is used to support the body weight (Oshita& Yano, 2010).As specificity is important for training-induced adaptations, performance changes in explosive neuromuscular actions may require specific training strategies and must consider the multi-planar and unilateral nature of most competitive soccer actions (Meylan et al., 2014). Therefore, there is a need for

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soccer-specific training interventions that incorporate multi-directional unilateral and bilateral force production exercises. Although a background knowledge of single exercise characteristics is helpful when planning for training programs (Makaruk, 2011), it would be important to know the effect of unilateral and bilateral exercises because these modes of muscle action are present during soccer games.

Conclusion

Due to URT, UPT as well as bilateral training the soccer player's skill performance was greatly improved. Though, UPT was much better than bilateral training whereas insignificant differences were found between UPT and URT groups and also between URT and bilateral training. Following 12 weeks of URT, UPT and BT treatment, soccer skill performance (URT=10.57%, UPT=10.94% and BT=6.05%), enhanced greatly. This may be due to greater neuromuscular adaptations as a result of the greater load imposed and/or the specificity of training during single leg exercise protocols. Due to the nature of soccer game, which involves single-leg actions, unilateral training may be a highly effective and safe training modality for optimizing skill performance of soccer players.

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