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Effect of Plyometric Exercises on Developing Legs Explosive Powers on Front Acrobatic Routine for Floor Exercises (Front Handspring Followed By Front Full Twist Then Full Twist with Turn around Long Axis).

Ashraf Abdel Aal

Asst. Professor, Exercises and gymnastic training department, Faculty of physical Education for Men, Alexandria university. Egypt.

Abstract

During republic champion, researcher noticed the inability of many of players involved in Republic championships in performance of front routines, in particular, represented by the lack of linkage between the parts of the routine and thus lead to decrease in their grades, making them out of competition on floor exercise despite the high level of performance on other devices. So it was important to develop plyometric training program form of exercises similar with kinetic path for the acrobatic routine under study and identify its impact on its performance level.

Research Objective:

This research aims to effect of plyometric exercises on developing legs explosive powers on front acrobatic routine performance level and some physical elements relating to it.

Conclusions:

- 1-Using plyometric training has effective effect in developing physical abilities and explosive power specially of arms and legs.*
- 2-Development of legs explosive power led to improvement in skill performance level.*
- 3-Development of legs explosive power led to the development of other elements (power) , motor range and flexibility for muscle involved in performance skills.*
- 4-The presence of a high correlation between skill performance level and explosive power.*

Recommendations:

- 1-There is necessity to pay attention to plyometric training in gymnastics selection of exercises cope with working muscle contractions methods in different skills performance.*
- 2-Gymnastics trainers should pay interest to change training programs types and use plyometric training method; especially with juniors as it have positive impact on Gymnastics skill performance.*
- 3-Conducting similar studies for different age stages and level for male and female players.*
- 4-Plyometric training program to be included as part of physical education curricula.*
- 5-Preparation of scalable training program suitable for application of different ages to contribute in improving skill performance level of gymnastics ground movements .*

Introduction:

Design of training programs in gymnastics, specially skills needs specific expertise, as innovating new methods associated with the nature of skills performance. Therefore the researcher used the plyometric training to develop explosive power of the legs as one of specific methods associated with the nature of front acrobatic routine performance under discussion, which this type is based on muscle exercises while stretching (decentralized contraction) resulting in strong explosive contraction (central contraction) improves the level of development operations. (Medhat El Shafei, 2005: p526)

The front acrobatic routine is one of somersaults and turns group which is one of the main compound groups in floor exercises, and is considered a prerequisite in kinetic routine according to international law. (International Gymnastics Federation, 2006: p36)

Egyptian Gymnastics Federation has developed some acrobatic front routines for various astages, including the routine under study, front handspring followed by front full twist then full twist with turn 360° around long axis.

Through researcher's work as coach and judge, he noted the inability of many of players involved in Republic championships in performance of front routines, in particular, represented by the lack of linkage between the parts of the routine and thus lead to decrease in their grades, making them out of competition on floor exercise despite the high level of performance on other devices.

Researcher, therefore, developed plyometric training program in form of exercises similar with kinetic path for the acrobatic routine

under study and identify its impact on its performance level.

Research Objective:

This research aims to effect of plyometric exercises on developing legs explosive powers on front acrobatic routine performance level and some physical elements relating to it.

Research hypotheses:

- 1- Training program had a positive effect on some physical elements related to routine under study.
- 2- Plyometric training program for developing legs explosive power positively affect front acrobatic routine performance level.

Research procedures:

This research was conducted during 3 months from June to August 2009, in Sport Establishment Club sports hall due to availability facilities required.

Research Sample:

The research sample was selected intentionally of from gymnasts at Alexandria area under 13 years age; 10 gymnasts participated in the study divided into two equal groups; one experimental and the other control, both were homogeneous in basic variables and some special physical elements and judges' assessment degrees of the level of skill performance.

Pilot studies:

The first pilot study:

The study was conducted during under 3 years juniors training to ensure the validity of devices used and see how much program exercises suite study sample.

Table (1)
Statistical significance for basic variables and physical measurements and judges skill level degrees for overall study sample before experiment
n = 10

Statistical indicators		Physical and skill measurements and tests	unit	Mean	SD	Skewness	Kurtosis	variation
Basic Variables		Age	Year	12.83	0.51	-0.67	-1.18	3.97
		Length	Cm	142.9	2.08	-0.3	-1.62	1.45
		Weight	Kg	38.5	3.37	-0.17	-1.01	8.75
Power	Arms	Arms bent from of pivot / 10sec	repetition	9.3	0.48	1.04	-1.22	5.16
		Arms bent from hanging / 10 sec	repetition	9.3	0.67	-0.43	-0.28	7.2
		Push ground with arms from oblique laying	repetition	12.4	0.52	0.48	-2.28	4.19
	Trunk	Lift legs from lying	repetition	10.5	0.53	0	-2.57	5.04
		Lift legs from hanging	repetition	7.1	0.32	3.16	10	4.5
		Lift back and arms from lying	repetition	15.3	0.48	1.04	-1.22	3.13
	Legs	Long jump	Cm	209	0.82	0	-1.39	0.39
		Vertical jump	Cm	40.9	0.99	0.24	-2.3	2.42
	Motor Range	Dome		Cm	5.4	0.7	1.66	2.05
Bent trunk down forward		Cm	12.5	0.53	0	-2.57	4.24	
Bent arms by degree		Mark	31.3	1.06	-0.04	-1.24	3.38	
Legs backward by degree		Mark	22.3	2.5	0.16	-2.36	11.21	
Skill Level Mark	Front straight full twist		Mark	3.9	0.74	0.17	-0.73	18.97
	Straight full twist with turn around long axis		Mark	3.4	0.7	1.66	2.05	20.58
	Two skills linking		Mark	2.8	0.6	0.41	-1.07	21.42

Table (1) for statistical significance for basic variables and physical measurements and judges skill level degrees for overall study sample before experiment results reveal that

skewness were between (± 3) for whole sample which indicates that it is under normal curve and that variances are in the accepted level for sample homogeneous.

Table (2)
Statistical significance for basic variables and physical measurements and judges skill level degrees for
experimental and control groups before experiment
n = 10

Statistical indicators		unit	Experimental group		Control group		Mean differences	T	Significance	
			Mean	SD	Mean	SD				
Basic Variables	Age	Year	12.69	0.53	12.96	0.52	-0.27	-0.82	0.44	
	Length	Cm	143	2.12	142.8	2.28	0.2	0.14	0.89	
	Weight	Kg	39	4.42	38	2.35	1	0.45	0.67	
Power	Arms	Arms bent from of pivot / 10sec	repetition	9.2	0.45	9.4	0.55	-0.2	-0.63	0.54
		Arms bent from hanging / 10 sec	repetition	8	0.71	8.6	0.55	-0.6	-1.5	0.17
		Push ground with arms from oblique laying	repetition	12.4	0.55	12.4	0.55	0	0	1
	Trunk	Lift legs from lying	repetition	10.6	0.55	10.4	0.55	0.2	0.58	0.58
		Lift legs from hanging	repetition	7	0	7.2	0.45	-0.2	-1	0.35
		Lift back and arms from lying	repetition	15.2	0.45	15.4	0.55	-0.2	-0.63	0.54
	Legs	Long jump	Cm	209	1	209	0.71	0	0	1
		Vertical jump	Cm	40.8	1.1	41	1	-0.2	-0.3	0.77
Motor Range	Dome	Cm	5.4	0.89	5.4	0.55	0	0	1	
	Bent trunk down forward	Cm	12.6	0.55	12.4	0.55	0.2	0.58	0.58	
	Bent arms by degree	Mark	31.6	1.14	31	1	0.6	0.88	0.4	
	Legs backward by degree	Mark	23	2.74	21.6	2.3	1.4	0.88	0.41	
Skill Level Mark	Front straight full twist	Mark	3.8	0.84	4	0.71	-0.2	-0.41	0.68	
	Straight full twist with turn around long axis	Mark	3.2	0.45	3.6	0.89	-0.4	-0.89	0.4	
	Two skills linking	Mark	2.6	0.55	3	1	-0.4	-0.78	0.46	

T sig. at 0.05 = 2.36

Table (2) for statistical significance for basic variables and physical measurements and judges skill level degrees for experimental and control groups before experiment results reveal no significant differences between the two groups which means that they are homogeneous

The second pilot study:

Researcher has identified the most important measurements and tests that measure physical elements (appendix 1) and designed performance evaluation sheet for front acrobatic routine (appendix 2).

Skill Performance level assessment:

Skill performance level assessment for front acrobatic routine under study was done by judges authorized by Egyptian Gymnastics Federation.

Program duration:

- Experiment took three months (12 weeks) with 3 sessions per week during the period from June to August 2009. appendix (3)
- The researcher the plyometric exercise training program to develop explosive power for legs. Appendix (3)

Post measurement:

After completion of experiment post measurements carried out of all measurements applied in the same way and conditions that took place in the pre measurement, results were recorded; statistical work done in order to arrive to research results.

Statistical work used:

- 1 - Mean
- 2 - standard deviation (SD).
- 3 – Skewness factor.
- 4 – Variation coefficient.
- 5 – T test.

6 - Percentage

7 – Improvement percentage.

8 - Correlation coefficient.

Results and discussion:

Table (3) for statistical significance for physical measurements and judges skill level degrees for experimental group before and after experiment reveal that :

Existence of statistically significant differences at 0.05 level in all measurements of power, e.g. number of Lift legs from hanging in 10 seconds was 7.00 times before the experiment and reached 9.200 times At the end of the experiment with difference of 2.2 and this difference is significant at at 0.05 level ($t = 11.00$) and same picture repeated for measurements of explosive power - For example, vertical jump was 40.800 cm before experiment improved to 50.800 cm after experiment with difference 10.00 cm and this difference is significant at 0.05 ($t= 11.18$).

For measurements of the motor range improvement is clear in favor of post measurement of this group as T value were (9,14.7,12.67,14.0), respectively, with statistically significant differences.

Consequent this group was superior in judges skill level evaluation after experiment than before it with significant T values (12.55,18.26, 17.42) respectively).

Table (3)
Statistical significance for physical measurements and judges skill level degrees for
experimental group before and after experiment **n= 5**

Statistical indicators Physical and skill measurements and tests		unit	Pre- Measurement		Post- measurements		Mean differences	T	Significance	Improvement percentage %	
			Mean	SD	Mean	SD					
Power	Arms	Arms bent from of pivot / 10sec	repetition	9.20	0.45	10.80	0.45	1.60	6.53*	0.00	17.39
		Arms bent from hanging / 10 sec	repetition	8.00	0.71	10.40	0.55	2.40	6.00*	0.00	30.00
		Push ground with arms from oblique laying	repetition	12.40	0.55	14.20	0.45	1.80	9.00*	0.00	14.52
	Trunk	Lift legs from lying	repetition	10.60	0.55	12.80	0.84	2.20	11.00*	0.00	20.75
		Lift legs from hanging	repetition	7.00	0.00	9.20	0.45	2.20	11.00*	0.00	31.43
		Lift back and arms from lying	repetition	15.20	0.45	17.20	0.45	2.00	-	-	13.16
	Legs	Long jump	Cm	209.00	1.00	222.00	2.74	13.00	8.76*	0.00	6.22
		Vertical jump	Cm	40.80	1.10	50.80	1.79	10.00	11.18*	0.00	24.51
Motor Range	Dome	Cm	5.40	0.89	0.90	0.22	-4.50	-9.00*	0.00	83.33	
	Bent trunk down forward	Cm	12.60	0.55	16.20	0.45	3.60	14.70*	0.00	28.57	
	Bent arms by degree	Mark	31.60	1.14	39.20	0.45	7.60	12.67*	0.00	24.05	
	Legs backward by degree	Mark	23.00	2.74	37.00	2.74	14.00	14.00*	0.00	60.87	
Skill Level Mark	Front straight full twist	Mark	3.80	0.84	9.20	0.27	5.40	12.55*	0.00	142.11	
	Straight full twist with turn around long axis	Mark	3.20	0.45	8.20	0.27	5.00	18.26*	0.00	156.25	
	Two skills linking	Mark	2.60	0.55	9.00	0.35	6.40	17.42*	0.00	246.15	

T sig. at 0.05 level = 2.766

From table (4) for statistical significance for physical measurements and judges skill level degrees for control group before and after experiment

the level of performance skill for exercises subject of research in the control group before and after the experiment, it is clear that there is statistically significant

differences at 0.05 level of 33.333% of total measurements, While the rest (66.66%) did not show statistically significant differences at 0.05 level even though this mean differences were in favor of post measurements, which means that there was improvement but not met significance criteria.

Table (4)
Statistical significance for physical measurements and judges skill level degrees for
control group before and after experiment **n= 5**

Statistical indicators		Physical and skill measurements and tests	Unit	Pre-measurement		Post-measurements		Mean differences	T	Significance	Improvement Percentage %
				Mean	SD	Mean	SD				
Power	Arms	Arms bent from of pivot / 10sec	repetition	9.40	0.55	9.80	0.84	0.40	1.63	0.18	4.26
		Arms bent from hanging / 10 sec	repetition	8.60	0.55	7.80	0.45	-0.80	-2.14	0.10	-9.30
		Push ground with arms from oblique laying	repetition	12.40	0.55	12.20	0.45	-0.20	-1.00	0.37	-1.61
	Trunk	Lift legs from lying	repetition	14.40	0.55	11.20	0.45	0.80	4.00*	0.02	7.69
		Lift legs from hanging	repetition	7.20	0.45	7.60	0.55	0.40	1.63	0.18	5.56
		Lift back and arms from lying	repetition	15.40	0.55	15.60	0.55	0.20	1.00	0.37	1.30
	Legs	Long jump	Cm	209.90	0.71	209.60	0.55	0.60	1.50	0.21	0.29
		Vertical jump	Cm	41.00	1.00	42.80	1.30	1.80	4.81*	0.01	4.39
Motor	Range	Dome	Cm	5.40	0.55	0.80	0.45	-2.45	-0.55	0.07	-11.11
		Bent trunk down forward	Cm	12.40	0.55	13.40	0.55	1.00	-	-	8.06
		Bent arms by degree	Mark	31.00	1.00	31.00	0.55	0.60	2.45	0.07	1.94
		Legs backward by degree	Mark	21.60	2.30	27.80	2.59	6.20	3.50*	0.02	28.70
Skill Level	Mark	Front straight full twist	Mark	4.00	0.71	5.60	0.55	1.60	7.00*	0.02	40.00
		Straight full twist with turn around long axis	Mark	3.60	0.89	4.60	0.89	1.00	-	-	27.78
		Two skills linking	Mark	3.00	1.00	4.80	0.76	1.80	5.31*	0.01	60.00

T sig. at 0.05 level = 2.766

Table (5) and Figures (1 to 3) for physical measurements and judges skill level degrees between control and experimental groups after experiment results reveal the superiority of experimental group in all measurements and test applied :(power – explosive power – motor range) which led to improvement in Judges' score for skill level (T = 13.15, 8.61) respectively.

Accordingly, researcher can attribute experimental group improvement compared with what control group achieved to the program nature for experimental group , which is based on using plyometric exercise to develop explosive power as described in appendix (3).

Table (5)
Statistical significance for physical measurements and judges skill level degrees between control and experimental groups after experiment
n= 5

Statistical indicators		Unit	Experimental group n=5		Control Group n=5		Mean differences	T	Sig.	ϵ_2	Effect size	Effect size significance	
			Mean	SD	Mean	SD							
Power	Arms	Arms bent from of pivot / 10sec	repetition	10.45	0.45	9.80	0.84	1.00	2.36*	0.05	0.41	1.49	High
		Arms bent from hanging / 10 sec	repetition	10.40	0.55	7.80	0.45	2.60	8.22*	0.00	0.89	5.20	High
		Push ground with arms from oblique laying	repetition	14.20	0.45	12.20	0.45	2.00	7.07*	0.00	0.86	4.47	High
	Trunk	Lift legs from lying	repetition	12.80	0.84	11.20	0.45	1.60	3.77*	0.01	0.64	2.39	High
		Lift legs from hanging	repetition	9.20	0.45	7.60	0.55	1.60	5.06*	0.00	0.76	3.20	High
		Lift back and arms from lying	repetition	17.20	0.45	15.60	0.55	1.60	5.06*	0.00	0.76	3.20	High
	Legs	Long jump	Cm	222.00	2.74	209.06	0.55	12.40	9.93*	0.00	0.92	6.28	High
		Vertical jump	Cm	50.80	1.79	42.80	1.30	8.00	8.08*	0.00	0.89	5.11	High
	Motor Range	Dome	Cm	0.90	0.22	4.80	0.45	-3.90	-17.44*	0.00	0.97	-11.03	High
Bent trunk down forward		Cm	16.20	0.45	13.40	0.55	2.80	8.85*	0.00	0.91	5.60	High	
Bent arms by degree		Mark	39.20	0.45	31.60	0.55	7.60	24.03*	0.00	0.99	15.20	High	
Legs backward by degree		Mark	37.00	2.74	27.80	2.59	9.20	5.46*	0.00	0.79	3.45	High	
Skill Level Mark	Front straight full twist	Mark	9.20	0.27	5.60	0.55	3.60	13.15*	0.00	0.96	8.31	High	
	Straight full twist with turn around long axis	Mark	8.20	0.27	4.60	0.89	3.60	8.61*	0.00	0.90	5.44	High	
	Two skills linking	Mark	9.00	0.35	4.80	0.76	4.20	11.22*	0.00	0.94	7.10	High	

T sig. at 0.05 level = 2.306

Fig (1)
Power measurements mean values for experimental and control groups after experiment

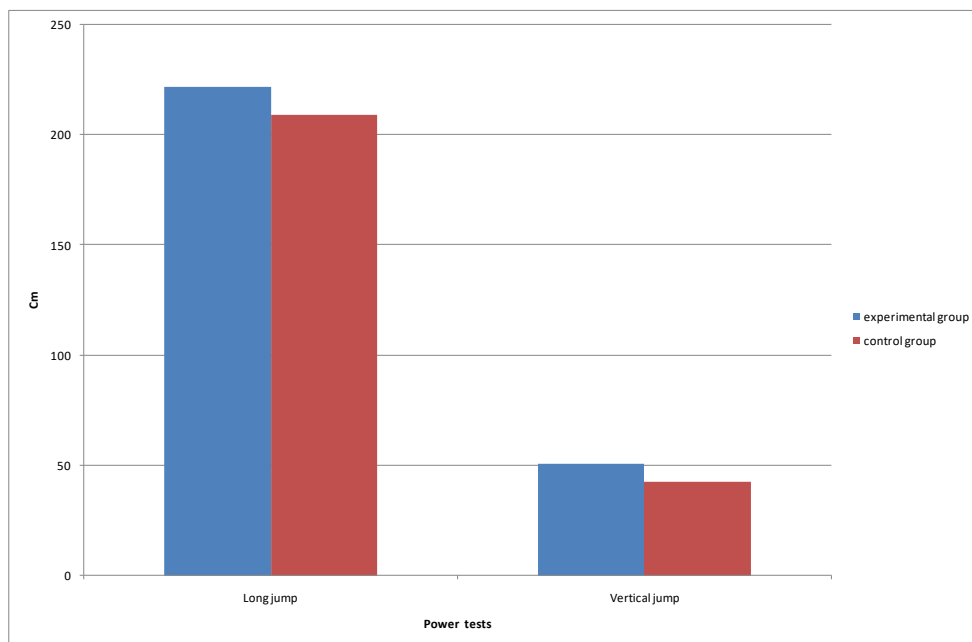
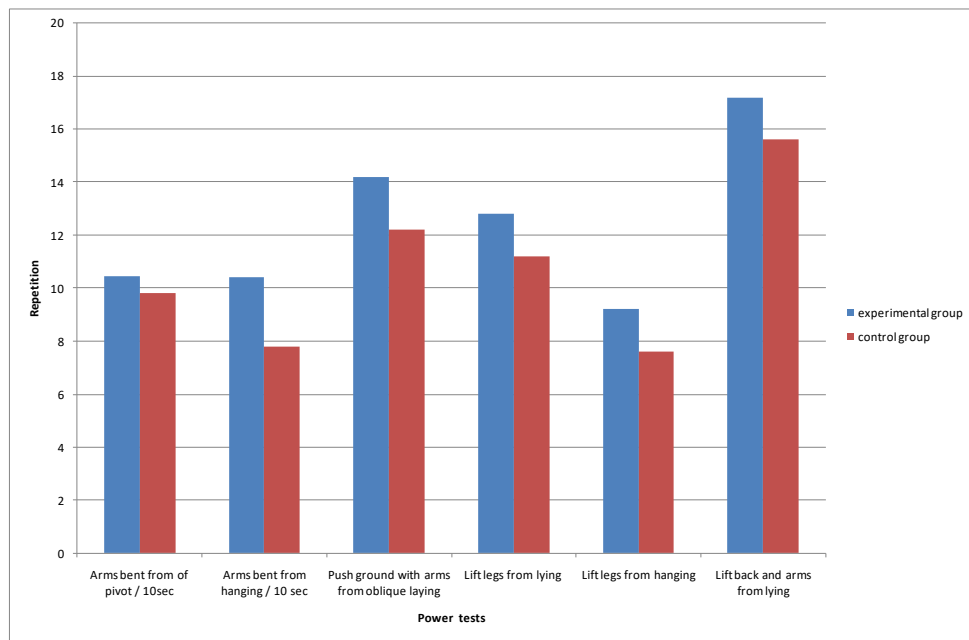


Fig (2)
Motor range measurements mean values for experimental and control groups after experiment

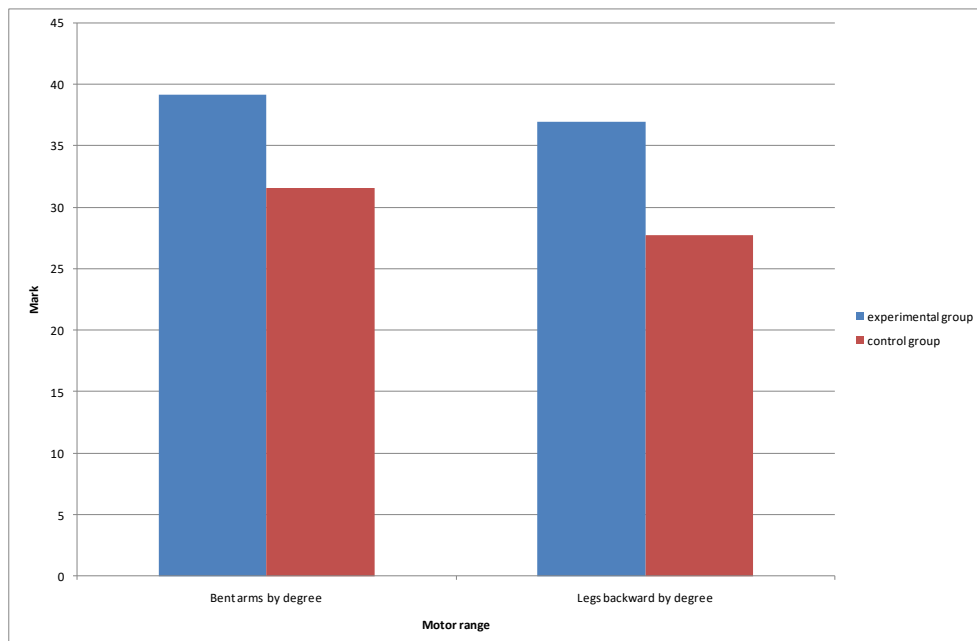
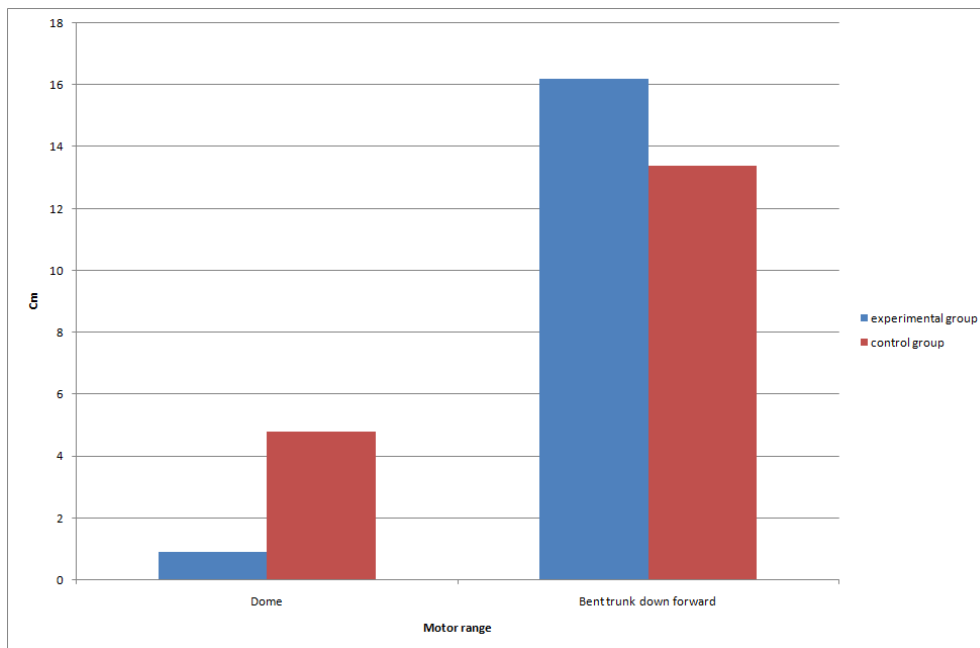
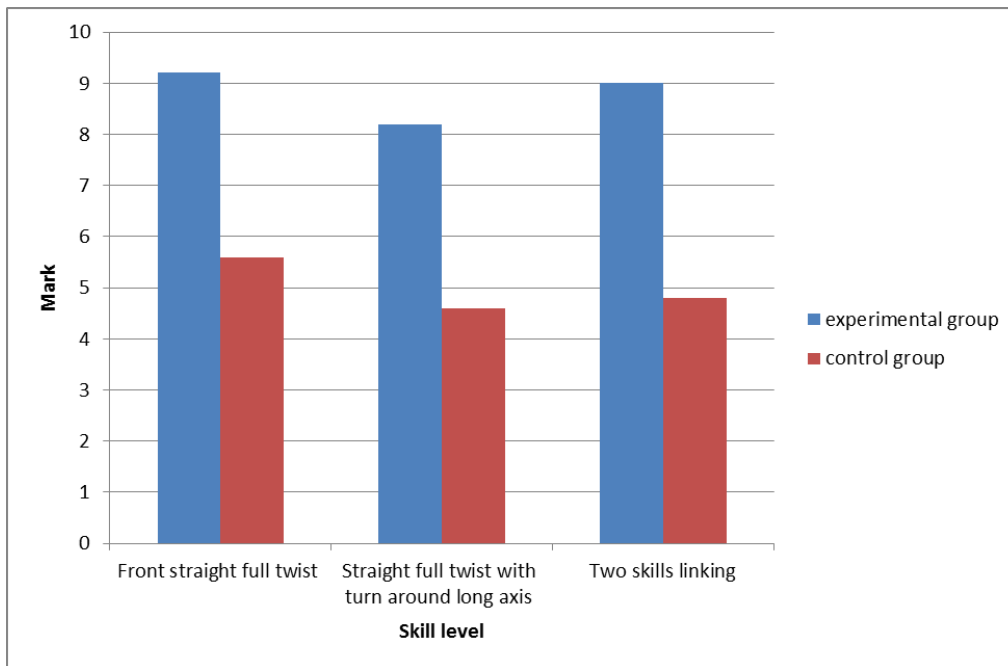


Fig (3)
Skill level score mean values for experimental and control groups after experiment



Tale (6) results show that improvement percentage for experimental group was higher than that of control groups in all measurements and tests applied.

Table (6)
improvement percentage for research groups after experiment

Variables	Groups	
	Experimental Group	Control group
Arms bent from of pivot / 10sec	17.391	4.255
Arms bent from hanging / 10 sec	30.000	9.302
Push ground with arms from oblique laying	14.561	1.587
Lift legs from lying	20.745	7.692
Lift legs from hanging	31.428	5.555
Lift back and arms from lying	13.157	1.298
Long jump	448.275	0.287
Vertical jump	24.409	4.390
Dome	60.000	11.111
Bent trunk down forward	28.579	8.064
Bent arms by degree	24.050	1.935
Legs backward by degree	17.391	17.796
front handspring	142.105	40.000
Front straight full twist	173.333	27.777
the twp skills with turn around long axis	844.307	60.000

Table (7)
Correlation coefficient between skill level and physical measurements and test for overall rserach sample

Statistical indicators		Unit	Front straight full twist	Straight full twist with turn around long axis	Straight full twist with turn around long axis
Physical and skill variables					
Power	Arms bent from of pivot / 10sec	repetition	0.801	0.853	0.822
	Arms bent from hanging / 10 sec	repetition	0.119	0.08	0.124
	Push ground with arms from oblique laying	repetition	0.8	0.88	0.822
	Lift legs from lying	repetition	0.867	0.881	0.874
	Lift legs from hanging	repetition	0.908	0.932	0.939
	Lift back and arms from lying	repetition	0.883	0.882	0.895
Explosive power	Long jump	Cm	0.887	0.902	0.887
	Vertical jump	Cm	0.934	0.961	0.969
Motor range	Dome	Cm	0.925	0.913	0.923
	Bent trunk down forward	Cm	0.971	0.94	0.956
	Bent arms by degree	Mark	0.921	0.935	0.941
	Legs backward by degree	Mark	0.832	0.795	0.832
Motor range	Front straight full twist	Mark	-	0.929	0.968
	Straight full twist with turn around long axis	Mark	0.929	-	0.977
	Two skills linking	Mark	0.968	0.977	-

Table (7) results reveal high correlation between skill level and all physical measurements and tests applied except for bent knee from hanging

Discussion:

Tables (6), (7), (8) results reveal existence of statistically significant difference between pre and post measurements for physical

measurements (power-explosive power – motor range) in favor of post measurement and between measurements and improvement percentages for research groups in favor of experimental group. This indicates the effectiveness of plyometric training exercises in the program , where they work in the same direction as muscular work required for of explosive power development required for

developing acrobatic routine under study, which have positive effect on improving power, motor range, and hence the acrobatic routine, as demonstrated by results of T test. These results is consistent with Asia Solimon (2005), Hosni Sayyid Ahmad , Hazem Hassan (2003), Mohamed Shawky, and Amr Allah Busatti (2002) Maha Amin (2000), Yasser Ashour (1999), studies results which refers to the preference of plyometric training in improving explosive power, which helped to improve skill performance level under discussion.

Mohammed Jalal (2004: p5) and Osama Abdel Fattah (2004: p9) and Zaky Darwish (1998: p5) Mike Hebert (1991: 22), Moran and Glynn (1990: p96) emphasized on the importance of plyometric training as the best way to develop explosive power where this method has contributed to overcome problems of explosive power development.

Dintiman et al (1998: p122) and Abo Elela Abdelfattah (1997: p22) argues that plyometric training is one of the influential and ideal training methods that could be used in explosive power development and legs muscles' speed.

These results also agreed with Mohammed Jalal (2004) and Ashraf Abdel Elaal and Muna Elsayed. (2003) and Costello (1984) studies results which concluded the effectiveness of plyometric training in improving power.

From what mentioned above, it is possible to conclude that plyometric training program positively affect some physical elements associated with acrobatic routine under discussion. This fulfill first hypothesis.

Second hypothesis : "Plyometric training program for positively affect front acrobatic routine performance level" validation is illustrated by tables (6), (7), (8) which

indicate existence of statistically significant difference between pre and post measurements for skill performance level in favor of post measurement and between measurements and improvement percentages for research groups in favor of experimental group. These results show that skill performance level has been improved as a result of development of explosive power and other physical variables through plyometric training program applied.

These results agreed with malaka Elrefaay and the Iman Soliman (1993) Maha Amin (2000), Ashraf Abdelaal and Mona Elsayed. (2003), Khalid Mahmood (2005) Saeed Ghonemy (2008) Ostilo (1983), studies results which all agreed that plyometric training positively affect skill level generally and acrobatic routine under study particularly

This is also consistent with what Mike Hebert (1991: p22) argued that plyometric training considered one of the most important types of exercises that contribute to improvement of some physical abilities , most important of them is explosive power that have an impact on skill performance level of many of jumping and pushing skills.)

Talha Hossam El Din (1997:pp80-9), quoting from Chu that plyometric training is the link between muscle strength and power and that is the main entrance to improve performance level through these tow muscle characteristics, and that plyometric training works to direct this strength in appropriate path to improve performance speed.

Conclusions:

Based on the results that have been reached and that associated with research objectives and in light of the methodology used and within limits of sample used, researcher reached the following conclusions:

- 1-Using plyometric training has effective effect in developing physical abilities and explosive power specially of arms and legs.
- 2-Development of legs explosive power led to improvement in skill performance level.
- 3-Development of legs explosive power led to the development of other elements (power) , motor range and flexibility for muscle involved in performance skills.
- 4-The presence of a high correlation between skill performance level and explosive power.

Recommendations:

In light of the results that have been reached through research; researcher recommends the following:

- 1-There is necessity to pay attention to plyometric training in gymnastics selection of exercises cope with working muscle contractions methods in different skills performance.
- 2-Gymnastics trainers should pay interest to change training programs types and use plyometric training method, especially with juniors as it have positive impact on Gymnastics skill performance.
- 3-Conducting similar studies for different age stages and level for male and female players.
- 4-Plyometric training program to be included as part of physical education curricula.
- 5-Preparation of scalable training program suitable for application of different ages to contribute in improving skill

performance level of gymnastics ground movements.

- 6-Attention should be given to conduct training courses for newly graduated coaches working in gymnastics training about “how to develop plyometric training programs on various artistic gymnastics equipment.

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