Theories & Applications the International Edition
Printed Version: (ISSN 2090-5262)
Online Version: (ISSN 2090-5270)
July 2011, Volume 1, No. 2 Pages (90 - 107)

The Effect of Using the Rotation Device Modified in the Drag and Resistance Styles on the Level of Some Kinematical and Functional Variables and the Numerical Achievement for the Hammer Throw Event.

*Medhat A. Salem *, El-Sayed S. El-Sayed **, Mohamed A. El-Sayed ****

Introduction:

Numerous studies were conducted with the aim of designing demonstrative laboratory models of performing human movements, aiming at improving such movements. These studies revealed the functional and mechanical factors of the motor skill requirements. (16: 219)

The competition of throwing the hammer is one of the complicated motor skills in track and field events. The complication of the skill is largely due to the technique used which requires an alternation of some increasing rotation movements in a limited space (circle limit and throwing limit) and the effect of such movements on the body balance system. (3: 532).

The technical performance of hammer throw should, therefore, link between the kinetic tracks of the body parts participating in the movement to produce a momentum that is consistent with the sound kinetic track. This should be consistent as well with the desired collected intensity resources which affect the amount of intensity of the working muscles group whose performance technique requires a high accuracy of the hammer thrower, and coordination between the stages of the skill technical performance, and the suitable instructions of the final effort through utilizing the mechanical bases of the performance. (11:124)

The results and field application of the biomechanical analysis in training lead to improving the technique and developing the mechanical aspects which the numerical achievement depend on when assessing the technical performance objectively, as it is based on studying the performance details through changing such details into quantitative values to enable the trainer to follow up all that happens during the performance. (1:22) (12:20).

Besides, the mechanical side of the hammer throwing is based on increasing the speed of the hammer and keeping the dynamic balance of the thrower. The actual distance covered depends on the following mechanical principles: the initial speed at the set - off – the set off angle – the height of set off level. (20:220 (9:281).

On the other hand, developing the physical abilities for any skill contributes to achieving faster and stronger results, so there should be sound planning to develop such abilities through training utilizing modern training methods and means to achieve the desired aim. The hammer throw event requires a great deal of energy, as

** Lecturer, Track and Field Events Training Department, The Faculty of Physical Education, Abu Qir, Alexandria University, Egypt*
*** Ass. Professor, Track and Field Events Training Department, The Faculty of Physical Education, Abu Qir, Alexandria University, Egypt*
**** Lecturer, Track and Field Events Training Department, The Faculty of Physical Education, Abu Qir, Alexandria University, Egypt*

the span of time spent during technical performance is longer than that of the other throwing events. Here, the thrower uses up a large amount of energy as a result of exerting the effort, resisting the hammer pull and trying to accelerate it. (15:421) (8:15).

During performance, maximum acceleration of the hammer is required, and that could be achieved from rotations around the longitudinal axis for 3 or 4 times, by exchanging focal between (heel and toes) to change the rotating movement into linear movement to get the best position for throwing. Any insufficiency out of the set motor track leads to failure of the try, so the thrower should have a high sense of reaching the kinetic dynamic balance during performance. This puts a great burden on the thrower, especially during rotation stage, and that balance could not be got but through the motor balance and the distinguished performance of the feet movements and the ideal distribution of the body, and increasing the speed or resistance. (2:67).

The rotation phase is considered as the most important technical performance phase in hammer throw as it has the greatest effect on the performance level, also any fault that might occur during this phase whether caused by outer or inner foot deviation will affect the effectiveness of the performance and would be a sign of weakness of the feet movements. Improving the feet movements helps the increase of dynamic balance indicators and mastering the technical complicated aspects of the skill.(8:26).

Although balance is an automated process, it is also an art as athletes can gain balance towards any possible dynamic action that might take place during performing and through balance drills are always that help create a functional adaptation situation in the vestibular analyzers. (13:184) (20:3)

This was the main aim of designing the modified rotation device with drag & resistance style. Using the device in training will minimize the negative effects that hinder the dynamic coordination, i.e., the responses during the rotational movement and movements control in relation to time and space, in addition to the accuracy of determining the required muscular effort necessary to keep balance. This is why the styles of pulling and resistance using the modified rotation device were introduced to create the functional adaptation and stability of performance (speed / rotation), and this would lead to increasing the effectiveness of motor performance and balance.

A pilot study of the 2009 National Championship showed a decline in the Egyptian numerical level, and it was noticed that many throwers either failed when trying to throw the hammer, or lacked balance during performance. The result was a technically or legally failing attempt. Consequently, it was necessary to examine the reasons for failure in performing of the correct motor track when throwing the hammer. The authors identified the major causes of failure as follows: losing balance; / slowing down of rotation speed, which is the basic factor of reaching a speedy performance; external feet deviations; lack of coordination in distributing fulcrum; and the turning in place of the individual fulcrum foot. This affects the distance of volunteer displacement, the duration of turning speed and the throwing distance (the motor track of fulcrum feet did not take their sound linear form).

Hence, we know the importance of the stage of pulling and resistance in the positive effect on the thrower's speed that suits the performance. This led the researchers to design the modified turn device, to identify its effect on some kinematical variables and functional efficiency processes of the body dynamic balance during rotation, and how the pulling and resistance

processes positively affect these variables under study.

The researchers noticed the weakness of the digital level of the hammer throwers in Egypt, and the weakness of the technical factors during the motor performance that is represented in the body deviations in the throwing circle during the rotation stage.These deviations negatively affects the adequacy of balance development.The researchers realized the important role of the vestibular system in keeping the dynamic balance during the technical stages of the competition, especially turns. Researchers referred to achieving the dynamic balance during the performance stages especially the stage of turning, through design the modified turn device to control the motor path of turns that develop the dynamic balance during the turn stage without affecting the basic components of the technical performance.

The method of pulling and resistance is built by using the modified device as each turn movement is resulted in two powers opposite in directions, a power of central pulling by muscles, and another of centrifugal affecting towards the radius. Thus, scientists stress the importance of increasing the speed of thrower's turn more than the speed of the hammer during the turn so as to increase accelerating of the hammer handle during fulcrum. (5:102) (7:4777) .

Controlling the skill performance is considered a training factor especially controlling the fulcrum to achieve the best path. (2:41).

The researchers suggest that this is the aim of designing the turn device, to change the turning movement into linear in the direction of throwing place without deviation. Helping and resisting factor during turning to avoid turning in the place and achieve the desired displacement that occurs in the device through pulling the wire fixed at the end of the device, or pulling for resistance. So, trainer should be sure that the wire of the cylinder is fully straight, then the competitor turns in the pole that carries the cylinder, caused by turning of (cone polar) at which the thrower is tied. This leads to shortening the wire that is fixed to a nail on the upper base towards the throwing direction, then a pull for the car and the player occurs without deviation of the focal feet, then the speed of the turn increased, and in each turn there is a pull that decreases the wire and gives a strength of pulling towards turning direction till leaving the hammer. To add resistance, the reverse pull method is used in which the competitor stands wearing a jacket of performance facing the start area, while the wire of pulling is wrapped on the cylinder, and the player turns then towards the direction of start position, whereas the trainer pulls the rope tied in the nail of the car so as to give additional speed. In each turn, the trainer increases the speed gradually till the last turn, to make the wire straight fully. To produce resistance, the process is implemented reversely through putting loads on the car. Now, we can see the importance of the turn stage during the technical performance of throwing the hammer, and the effective impact on the level of technical performance, in general. Thus, the means works to prove the success of the final effort through concentrating and collecting the different powers of the body muscles participating in the motion in the same moment and in the desired motor path so as to provide the performance with the maximum speed and acceleration, besides, getting the longest distance as much as possible through proving success of the previous stage, ie. the turn stage. Figure 1.

Thus, the researchers tried to know more than one side to understand the reality of the performance of that technically complicated competition using the outstanding turn device

with the pull and resistance styles, and its effect on some of the kinematical variables and the indications of the functional efficiency of the competitors, and help avoid the external and internal deviations of the fulcrum of feet during training and the effect of all the previous factors on the level of numerical achievement.

Research Objective :

Recognizing the effect of using the modified turn device with the pull and resistance styles on some of the kinematical, skillful and physical variables, and the indicators of the functional efficiency and the numerical level of the hammer throwing event.

Research Hypotheses :

1. The suggested training programme positively affects the variables under study of the experimental and control groups.

2. Using the modified turn device with the pull and resistance styles positively affects some of the kinematical, skillful and physical variables of the junior players of the hammer throw competition

3. Using the modified turn device with the pull and resistance styles positively affects some of the functional efficiency and digital achievement of the junior players of the hammer throwing event

Previous Studies

Author	Title of Study	Aim	Method	Sample	Main results
Waheed, K. (2003)(20)	The effect of using the release flying curve on the way of releasing the hammer for beginners	Identifying the effect of using the release flying curve on some physical and kinematical variables of the way of releasing the hammer for beginners	experimental	Students of faculty of physical education, Alexandria (24)	The use of release flying curve helped improve release level and release angle and initial speed of hammer at the moment of release and improve throw distance
Dapena, J (2003)(5)	Predication of distance in hammer throwing	Identifying the effect of air resistance and hammer gravity centre coincident with the hammer centre	descriptive	Group of high level male and female archers	- The effect of air Resistance and the Assumption that Hammer gravity centre Is the same hammer Centre led to a greater Throwing distance than The actual distance - the effect of the real hammer gravity centre led to a lower throwing distance than the actual

Author	Title of Study	Aim	Method	Sample	Main results
					distance
Cookmeagen K., Steven J(2007)(4)	Muscular power and performance in the hammer throw	Identifying the Effect of muscular Power on the Technical performance Level in the hammer throw	experimental	6 high-Level competitors	The development of Lower and upper Muscles increases Efficiency of technical performance of Hammer throw Competitors
Dapena.J (2009)(6)	.A kinematical study of the centre of mass motion in the hammer throws	Identifying the Movement and speed Of the body from the Three main movement d Directions (horizontal - vertical)	descriptive	Case study	Studying the Mechanical performance of the body Mass centre leads to Knowing the general Movement, avoiding And ignoring motor Deviation with every Rotation
Sara M. & Kevin K. (2009)(18)	Development and validation of a method to directly measure the cable force during the hammer throw. "Jams Cook University, Australia 2009"	Developing the Special power has a Positive effect on Throwing distance In the hammer Throw event	experimental	8 first class competitors	Developing the Special power has a Positive effect on The digital level And technical performance In the hammer Throw event
Thomas P (2009)(19)	Kinematical analysis of the hammer throws in competition	Identifying the Effective kinematical Variables affecting The technical Performance of Hammer throwing	descriptive	-	The main kinematical Variables affecting The technical Performance of Hammer throwing Include quick release, Release angle, Performance speed, Height of release Point

Summary of the Previous Studies :

The previous studies addressed the most important factors affecting the technical performance of throwing the hammer, concerning the kinematical, functional and physical variables that relate to the concern of the current study represented in:

Speed of turn and angle of release most important factors for the success of the technical performance – the distance of throwing is positively related to with the length of the radius and its speed - caring for establishing the right motor type of the technical performance – increasing the duration of dual focal, and decreasing the duration of individual focal – increasing the pull intensity on the hammer during the dual focal – varying the use of tools and training of the training programme of hammer throw.

Study Procedure :

The two researchers used the experimental approach with the experimental design of two groups, an experimental group and a control one ((the experimental group (using turn device of pull and resistance styles) – the control group (traditional style)) with applying the measurements (pre – post) of the two groups.

Research Scopes :

Geographical Scope :

All the study measurements and applying of the programme were implemented in the track and field of the faculty of physical education for men, Alexandria University – physical fitness unit.

Time Scope :

All the research measurements and applying of the training programme were implemented from 26/9/2009 to 30/12/2009, at the rate of 4 training units weekly. The basic study was implemented from 1/10/2009 to 26/12/2009. The pre-measurements were done from 26/9/2009 to 28/12/2009, and the post-measurements from 28/12/2009 to 30/12/2009.

Human Scope :

Students of the faculty of physical education – Alexandria University, who achieved high numerical levels in the competition of hammer throwing totally.

Research Sample :

The study was implemented on an intended sample of the students of the faculty of physical education, according to age, physical measurements, motor abilities and the numerical achievement level. The sample consists of 16 students divided into two equal homogeneous groups, of 8 students each (control group and experimental one).

Homogeneity of sample

Table 1Arithmetic mean, standard deviation, torsion co-efficient of the research basic variables

Statistical treatment Variables	Arithmetic mean	Standard deviation	Torsion co-efficient
Height	179.25	1.04	0.87
Age	19.50	1.39	0.75
Weight	79.26	2.77	0.92
Vertical jump test	31.60	0.34	0.57
Bending forward from the waist	9.71	0.49	0.82
Pushing a 1 kgmmedical ball in front of chest	6.20	1.05	0.91
Leg extensor muscle strength	195.41	0.85	0.81

Statistical treatment Variables	Arithmetic mean	Standard deviation	Torsion co-efficient
Back extensor muscle strength	177.32	1.30	0.92
Forward Shot throw	8.87	0.65	0.60
Backward shot throw	9.84	0.54	0.54
Standing hammer Throw	19.75	0.92	0.65
Rotation hammer Throw	22.71	0.71	0.73

Table 1 shows that all torsion co-efficient values of the study variables vary between +3 and -3. This indicates normality of data and homogeneity of each level f the research sample

Equivalence of sample

Table 2The (T) test between the control and the experimental groups in pre-measurements of the research basic variables

Statistical treatment Variables	unit	Control group		Experimental Group		T
		X -	Z ±	X -	Z ±	
Height	Cm	179.25	1.84	178.24	1.64	1.06
Age	Year	19.50	0.51	19.50	0.54	1.08
Weight	Kgm	79.26	6.98	78.12	6.05	0.67
Vertical jump test	Cm	31.60	3.05	23.01	2.96	1.06
Bending forward from the waist	Cm	9.71	2.374	9.87	2.14	1.45
Pushing a 1 kgm medical ball in front of chest	M	6.20	1.95	6.23	1.62	1.63
Leg extensor muscle strength	Kgm	195.41	16.32	196.42	14.95	0.64
Back extensor muscle strength	Kgm	177.32	8.51	176.43	6.61	0.73
Forward Shot Throw	M	8.87	0.12	8.94	0.23	0.58
Backward shot Throw	M	9.84	0.87	9.46	0.67	0.94
Standing hammer Throw	M	19.75	1.51	20.64	1.82	1.037
Rotation hammerThrow	M	22.71	1.31	21.98	1.91	1.43

T tabular value at the 0.05 level=2.13

Table 2 shows that there are no statistically significant differences between the control and experimental groups in the basic variables in pre-measurements. This indicates the equivalence between the two groups before the research was conducted. This was done to select the sample in the intentional manner according to the required physical characteristics and abilities.

Tools of Data Collecting:

means of measurement / tests / videoing and analysis / rotation device modified with drag and resistance styles.

Study measurements and tests :

First : main anthropometric measurements : approximate age / approximate height in cm. / approximate weight in kg.

Second : physical measurements : utmost strength : measuring (strength of muscles of back and feet / fist strength / measuring the increasing speed : 30 m. jogging at slow start / strength characterized with speed : test of long and vertical jump from stability / test of muscles ability of feet : shot put , front and back throw with hands.

Third : skill tests of throw distance : hammer throw from stability (1-2-3) turn(s).

Fourth : kinematical measurements and the indications of functional efficiency (motor imaging), Dart Fish programme.

Duration of total performance of turn and focal / height of pelvis and body weight centre during turn.

Release angle / speed of performance / height of release point / evaluating the skill performance of the hammer throw.

Actions of focal and measuring the test of focal distance distribution, and the deviations of functional efficiency.

Fifth : measuring the numerical level : will be done according to the international rules of athletics for amateurs.

Tools and instruments used in the research :

Restameter / medical scale / stop watch / measurement tape of hammers of different weights (some are legal).

Rotation device modified by the drag and resistance styles (components / method of operation), appendix 1.

2 panasonic video camera / 2 mini-panasonic tapes / 2 tripod for the camera.

Water scale / adhesive plaster tape / scissors / computer / motor analysis programme.

Measurement board of 2m. divided into 20/20 cm. to determine the scale at width of 10 cm.

Tools and instruments of the hammer throw competition.

A ball / registering data form / lime / flags / wooden poles / medical balls with nets.

Pilot Studies:

The first pilot study

The two researchers implemented the first pilot study from 1/9/2009 to 3/9/2009. It aimed at :

1. making sure of the validity of the training means (the modified rotation device) and the instruments and tools used, especially the drag and resistance wire, and the modifications done on the old device.

2. making sure of the suitability of the training programme of the research sample.

The second pilot study

The researchers implemented the second pilot study on 10/9/2009. The necessary tools for videoing and the sample were prepared. Four competitors were videoed in six attempts according to the international rules principles for athletics. This study aims at recognizing the physical, kinematical and functional shortcomings of the hammer throw competitors, and overcoming the obstacles that may occur in the basic experiment, recognizing the suitable places of the cameras, especially for the danger of throwing processes so as not to collide with cameras, training on the suitable standing and the cameras directions, defining the kinematics variables of the hammer throw competition.

The main results of the study were :

Recognizing some of the technical, physical and skill shortcomings especially the feet actions during rotation.

Determining the suitable place of the cameras, as the distance between the first camera in the right side was 980 cm. and vertical above the player, and the distance between the second camera in the front side of the competitor was 840 cm. and the distance between the two cameras was 14 m.

Determining the kinematical variables: the total speed of device rush / the height of release point / the angle of device rush.

Determining the indicators of the functional aspect: individual and dual fulcra / lateral deviations of the three rotations.

Bases of designing the training programme :

The programme includes a group of motor exercises devoted for the motor path and the rotations. Connection between exercises and range of developing the motor and functional abilities by which they are performed is cared for, besides the motor integration and interdependence. The programme is also based on the principle of load and rest, gradient of load and individuality and using the periodical low and high intensity training. The maximum recurrence of the hammer throw of weight 5 kg., is12 times, and 9 times for that of 6 kg., and 7 times for that of 7.26 kg. Repetition is implemented in 3 groups. Measuring the maximum repetition should be measured every 2 weeks to determine the new maximum limit of repetition, with fixing the intensity for 12 weeks , 4 training units and adding the experimental variable of the experimental group.

Basic Study:

First: pre-measurements:

These measurements were implemented from 26/9/2009 to 28/9/2009 as follows:

First day : the anthropometric tests, the second day : the physical tests , the third day : numerical and skill tests, and the kinematical and functional efficiency.

Second: the basic study:

The suggested training programme of the hammer throw competition was implemented by inserting the experimental variable on the experimental group only, whereas the control group used the training programme of the exercises under study. The content of the suggested training programme was selected from the previous and theoretical studies. The training programme units were implemented on the performance of the two groups from 1/10/2009 to 26/12/2009, that is 12 weeks, each of 4 training units whose time is from 90 to 100 minutes.

Third : the post-measurements :

These measurements were implemented after the basic study has implemented, from 28/12/2009 to 30/12/2009 using the same tests of the pre-measurement and with the same provisions.

Statistical Treatments :

Arithmetic mean / standard deviation / torsion coefficient / value of T / SPSS programme to calculate some statistical coefficients / DART FISH programme of motor analysis.

Table 3: The Mean, SD and T values for the physical and technique variables in pre – post tests for the control group

Variables	Unit	Pre		Post		T
		Mean	±SD	Mean	±SD	
Low back muscles strength	Kg	١٢٤.٣٢	٧.٦١	١٣٥.٨٣	٥.٨٤	*٤.١٦
Leg muscles strength	Kg	١٨٧.٩٥	٧.٦٨	١٩٢.٦١	٨.٩٣	*٣.٩١
Average hand strength	Kg	٤٦.٤٠	٣.٦٥	٤٩.٣١	٤.٢٧	*٣.٨٤
30m standing start	Sec	٤.٩٨	١.٣٢	٤.٨١	٢.٨٥	*٢.٧٣
Standing long jump	cm	٢١٥.٩٢	٥.٩٦	٢٢٧.١٩	٣.٧٤	*٦.٧٣
Vertical jump	cm	٤٢.٦٤	١.٩٨	٤٤.٢٧	٢.٦١	*٥.٣٥
Forward shot throw	m	٨.٦٦	١.٤١	٩.١٣	٢.٠١	*٢.١٨
Backward shot throw	m	٨.٨٩	١.٥٢	١٠.٠٢	٢.١٤	*٣.٩٤
Low back flexibility test	cm	٨.٩٥	١.١٢	٩.٨٣	١.٦٢	*٢.٢٦
Shoulder flexibility	cm	٣٢.٤٦	٥.٨٣	٣٥.٢٦	٤.٧٣	*٣.٨٤
Standing hammer throw	m	١٣.٤١	٢.٨٥	١٤.٧٣	٢.٦٤	*٤.٨٢
One rotation hammer throw	m	٢٠.٢٣	٢.١٣	٢٢.١١	١.٩٨	*٢.٧٥
Two rotations hammer throw	m	٢٠.٨١	٢.٩٧	٢٢.٣٢	١.٨٧	*٣.٨٤
Three rotations hammer throw	m	٢١.٥٨	٢.٧٦	٢٣.٨٥	٢.١٥	*٤.٣٤

Value Significant 0.05 = 213

Table 3 shows significant differences in physical and technique Variables in pre-post tests for control group favoring the post test.

Table 4: The Mean, SD and T values for kinematics variables in pre – post tests for the control group

Variables	Unit	Pre		Post		T
		Mean	±SD	Mean	±SD	
Total performance time	Sec	٣.٠٦	٢.١١	٢.٩١	٢.٤٨	*٢.٩٣
First rotation time	Sec	١.٠٢	١.٣٥	٠.٩٦	٢.٥٣	*٣.٢٧
Second rotation time	Sec	٠.٩٩	٢.٨٥	٠.٩٤	١.٩٩	*٢.٧٥
Third rotation time	Sec	١.٠٣	٣.٩٥	٠.٩٩	٣.٢٥	*٤.٨٥
Single support time for first rotation	Sec	٠.٥٠	١.٩٦	٠.٤٧	٢.٠٢	*٣.٦١
Double support time for first rotation	Sec	٠.٥١	٥.٧٢	٠.٤٨	٣.٦٤	*٢.٨٧
Single support time for second rotation	Sec	٠.٤٩	٦٢٨	٠.٤٠	٢.٣٥	*٣.٩٥
Double support time in second rotation	Sec	٠.٥١	٣.٥١	٠.٤٤	٢.٥٣	*٢.٦٣
Single support time in third rotation	Sec	٠.٤٩	٤.٦٢	٠.٤٩	٢.٩٦	*٢.٥٨
Double support time in third rotation	Sec	٠.٤٨	١.٦٤	٠.٥٠	٢.٩٣	*٣.٢١
Total rotation velocity	m/s	٠.٣٤	٣.٨٣	٠.٣٧	٢.٩٥	*٢.٥٧

Variables	Unit	Pre		Post		T
		Mean	±SD	Mean	±SD	
Release performance velocity	m/s	١١.٠٥	٢.٠٤	١٢.٧٦	١.٨٥	*٢.٨٤
Resultant release velocity	m/s	١١.٣٤	١.٠٥	١٣.٩٧	١.١٥	*٣.٤١
Height of release point	M	١.٦٩	٢.٠٦	١.٨٣	١.٩٤	*٢.٨٤
Angle of release	O	٣٢.٢٥	٣.٠١	٣٥.٢٠	٢.١٩	*٣.٦٤

Value Significant 0.05= 213

Table 4 shows significant differences in kinematics variables in pre-post tests for the control group favoring the post test.

Table 5: The Mean, SD and T values for functional efficiency variables in the pre – post tests for the control group

Variables	Unit	Pre		Post		T
		Mean	±SD	Mean	±SD	
Right foot distance in start position to throwing line direction	Cm	٢٨.٠١	٣.٨٥	٢٤.٦٤	٣.٢٤	*٢.٩٨
left foot distance in start position to throwing line direction	Cm	٢٦.٧٢	٣.٩٥	٢٣.٨٦	٤.٨٧	*٣.٧٦
Right foot distance during first rotation to throwing line direction	Cm	١٥.٦٣	٢.٧٥	١٤.٥٣	١.٧٨	*٢.٥٦
Left foot distance during first rotation to throwing line direction	Cm	٣٣.٦٤	٢.٢٣	٣١.٢١	٢.٧٥	*٢.٧٩
Right foot distance during second rotation to throwing line direction	Cm	١٦.٧٣	٣.٦٣	١٥	٣.٢٣	*٣.٩٥
left foot distance during second rotation to throwing line direction	Cm	٢٢.٦٥	٥.٤٤	٢١	٤.٩٣	*٣.١٠
Right foot distance during third rotation to throwing line direction	Cm	١٦.٩٣	٤.٣٢	١٥	٣.٥٤	*٦.٨٣
Left foot distance during third rotation to throwing line direction	Cm	٣٥.٩٢	٧.٩٢	٣٤.٠٤	٥.٣٦	*٤.٢٨

Value Significant 0.05= 213

Table 5 shows significant differences in functional efficiency in the pre-post tests favoring post tests.

Table 6: The Mean, SD and T values for the physical and technique variables in pre – post tests for experimental group

Variables	Unit	Pre		Post		T
		Mean	±SD	Mean	±SD	
Low back muscles strength	Kg	129.35	2.73	162.35	4.32	6.74*
Leg muscles strength	Kg	190.11	5.83	243.61	3.75	8.51*
Average hand strength	Kg	46.90	3.69	50.92	3.25	2.97*
30m standing start	Sec	4.93	4.28	4.52	0.21	2.49*
Standing long jump	cm	217.26	5.32	237.84	2.97	8.71*
Vertical jump	cm	43.04	2.74	48.91	2.86	2.99*
Forward shot throw	m	8.35	2.78	10.30	3.38	3.09*
Backward shot throw	m	8.93	1.89	12.83	1.95	3.72*
Low back flexibility test	cm	8.56	1.60	9.97	1.86	2.82*
Shoulder flexibility	cm	31.98	1.64	36.29	2.69	4.83*
Standing hammer throw	m	13.65	1.87	17.86	2.94	2.93*
One rotation hammer throw	m	20.95	2.09	24.68	2.01	4.95*
Two rotations hammer throw	m	21.24	1.95	28.86	1.24	7.47*
Three rotations hammer throw	m	22.08	4.33	34.49	2.85	14.35*

Value Significant 0.05= 213

Table 6 shows significant differences in physical and technique variables in pre-post tests for the experimental group favoring the post test.

Table 7: The Mean, SD and T values for kinematics variables in pre – post tests for experimental group

Variables	Unit	Pre		Post		T
		Mean	±SD	Mean	±SD	
Total performance time	Sec	3.09	2.74	2.50	2.85	3.12*
First rotation time	Sec	1.04	1.91	0.89	2.43	2.93*
Second rotation time	Sec	0.98	1.19	0.84	2.96	2.64
Third rotation time	Sec	1.05	1.28	0.76	1.53	4.73
Single support time for first rotation	Sec	0.51	3.96	0.48	0.24	2.86*
Double support time for first rotation	Sec	0.53	3.72	0.41	2.85	2.99*
Single support time for second rotation	Sec	0.48	2.46	0.48	1.28	2.79*
Double support time in second rotation	Sec	0.50	1.96	0.36	2.12	2.48*

Variables	Unit	Pre		Post		T
		Mean	±SD	Mean	±SD	
Single support time in third rotation	Sec	0.52	1.86	0.34	2.85	3.98*
Double support time in third rotation	Sec	0.52	3.83	0.42	2.24	4.84*
Total rotation velocity	m/s	0.36	2.12	0.59	7.14	3.97*
Release performance velocity	m/s	11.34	3.11	16.73	1.64	4.13*
Resultant release velocity	m/s	11.65	2.45	18.81	2.85	3.87*
Height of release point	m	1.72	3.14	2.09	3.23	5.41*
Angle of release	°	34.73	2.91	43.28	5.24	4.72*

Value Significant 0.05= 213

Table 7 shows significant differences in kinematics variables in pre-post tests for experimental Group favoring the post test.

Table 8: The Mean, SD and T values for functional efficiency variables in pre – post tests for the experimental group

Variables	Unit	Pre		Post		T
		Mean	±SD	Mean	±SD	
Right foot distance in start position to throwing line direction	Cm	24.81	3.45	22.09	2.75	2.92*
left foot distance in start position to throwing line direction	Cm	24.08	3.81	22.13	3.46	2.18*
Right foot distance during first rotation to throwing line direction	Cm	15.69	2.26	18.35	2.89	3.34*
Left foot distance during first rotation to throwing line direction	Cm	30.62	2.74	19.32	4.71	11.61*
Right foot distance during second rotation to throwing line direction	Cm	15.37	2.95	17.23	3.82	2.93*
left foot distance during second rotation to throwing line direction	Cm	22.03	4.71	16.96	2.36	7.81*
Right foot distance during third rotation to throwing line direction	Cm	16.87	4.26	14.20	3.82	5.82*
Left foot distance during third rotation to throwing line direction	Cm	33.90	5.51	25.43	3.44	10.41*

Value Significant 0.05= 213

Table 8 shows significant differences in post test in all functional efficiency variables except in the pre- post tests of the experimental group favoring post tests

Table 9: The Mean, SD and T values for the physical and technique variables in post test between the control group and the experimental group

Variables	Unit	Pre		Post		T
		Mean	±SD	Mean	±SD	
Low back muscles strength	Kg	135.83	5.84	162.35	4.32	7.83*
Leg muscles strength	Kg	192.61	8.93	243.61	3.75	8.58*
Average hand strength	Kg	49.31	4.27	50.92	3.25	0.46*
30m standing start	Sec	4.81	2.85	4.52	0.21	2.93*
Standing long jump	cm	227.19	3.74	237.84	2.97	5.86*
Vertical jump	cm	44.27	2.61	48.91	2.86	2.19*
Forward shot throw	m	9.13	2.01	10.30	3.38	2.32*
Backward shot throw	m	10.02	2.14	12.83	1.95	3.36*
Low back flexibility test	cm	9.83	1.62	9.97	1.86	0.64*
Shoulder flexibility	cm	35.26	4.73	36.29	2.69	0.98*
Standing hammer throw	m	14.73	2.64	17.68	2.94	5.74*
One rotation hammer throw	m	22.11	1.98	24.68	2.01	3.61*
Two rotations hammer throw	m	22.32	1.87	28.86	1.24	11.62*
Three rotations hammer throw	m	23.85	2.15	34.49	2.85	13.73*

Value Significant 0.05= 213

Table 9 shows significant differences in physical and technique variables in post - test favoring the experimental group

Table 10: The Mean, SD and T values for kinematics variables in post test between the control group and the experimental group

Variables	Unit	Post		Post		T
		Mean	±SD	Mean	±SD	
Total performance time	Sec	2.91	2.48	2.49	2.85	4.58*
First rotation time	Sec	.096	2.5380.24	0.89	2.43	2.17*
Second rotation time	Sec	0.94	1.99	0.84	2.96	2.43*
Third rotation time	Sec	0.99	3.25	0.76	1.53	4.64*
Single support time for first rotation	Sec	0.47	2.02	0.48	0.24	0.94*
Double support time for first rotation	Sec	0.48	3.64	0.41	2.85	2.26*

Variables	Unit	Post		Post		T
		Mean	±SD	Mean	±SD	
Single support time for second rotation	Sec	0.40	2.35	0.48	1.28	2.38*
Double support time in second rotation	Sec	0.44	2.53	0.36	2.12	2.16*
Single support time in third rotation	Sec	0.49	2.96	0.34	2.85	5.24*
Double support time in third rotation	Sec	0.50	2.93	0.42	2.24	2.96*
Total rotation velocity	m/s	0.37	5.95	0.59	7.14	3.95*
Release performance velocity	m/s	12.76	1.85	16.73	1.64	5.71*
Resultant release velocity	m/s	13.97	1.15	18.81	2.85	4.41*
Height of release point	m	1.83	1.94	2.09	3.23	5.86*
Angle of release	؛	35.20	2.19	43.28	5.24	7.52*

Value Significant 0.05= 213 from

Table 10: show a significant difference in all kinematics variables in post test favoring the experimental group except Single support time for first rotation .

Table 11: The Mean, SD and T values for functional efficiency variables in post between the control group and the experimental group

Variables	Unit	Post		Post		T
		Mean	±SD	Mean	±SD	
Right foot distance in start position to throwing line direction	Cm	24.64	3.24	22.09	2.75	1.96*
left foot distance in start position to throwing line direction	Cm	23.86	4.87	22.13	3.46	2.05*
Right foot distance during first rotation to throwing line direction	Cm	14.53	1.78	18.35	2.98	2.10*
Left foot distance during first rotation to throwing line direction	Cm	31.21	2.75	19.32	4.71	9.53*
Right foot distance during second rotation to throwing line direction	Cm	15	3.23	17.23	3.82	2.23*
left foot distance during second rotation to throwing line direction	Cm	21	4.93	16.96	2.36	2.73*
Right foot distance during third rotation to throwing line direction	Cm	15	3.54	14.20	3.82	5.34*
Left foot distance during third rotation to throwing line direction	Cm	34.04	5.36	25.43	3.44	11.55*

Value Significant 0.05= 213

Table 11shows significant differences in post- test favoring the experimental group in all functional efficiency variables except the right and left foot distance in start position to throwing line direction and right foot distance during first rotation to throwing line direction .

Discussion of the outcomes:

Tables (3,6,4,7,5,8) show significant differences at the level of 0.05 in all the physical, skill and

kinematical variables and the indicators of functional efficiency between the pre and post measurements of the two groups, for the favour of the post-measurement as a result of the training programme and the alternative tools of the exercises of the different fitness factors which are needed for the technical performance. Besides, the contents of the standardized training programme of the two groups, and the use of the tools that suite the nature of the motor performance participated in developing the physical and motor factors. This goes with the validity of the first hypothesis and with is in (10) (17).

Table 9 shows significant differences of all the physical and skill variables except for the fist strength, the motor range of the back in the post-measurement for the favor of the experimental group as it used the training means of the modified rotation device, that led to achieving a long-term motion through the vertical trunk position without leaning backward to face the centrifugal force. This led to increase of preliminary speed of the hammer at the rush moment as a result of the speed length that affects it. This goes with agreed at in (1) (2) where it is confirmed that it is important to achieve a long range of motion and balance of performance through keeping the sound rotation and the means using the style of drag and resistance. This kept the preliminary speed that has a positive relationship with the length of the speed affecting the performance, and participated so positively in keeping the sound position of body during rotation. This led to improvement of the numerical levels during throwing whether they are one rotation or two or three. (14) suggests that the positions of the body, trunk and the knees play an important role in directing the hammer in a maximum motor path during rotations, and the improvement resulted for the skill factors is attributed to the control of the motor path of rotation stage during learning rotations through the exercises of training means by drag and resistance, that led to increase of the strength of feet and back muscles, that affect all the physical variables under study. This also is consistent with the validity of the first hypothesis.

Table 10 shows significant differences in all the kinematical variables except the duration of individual fulcrum of the first rotation of the measures, (pre and post ones) of the two groups, (the control and experimental) for the favour of the experimental one because of the use of the modified rotation device by the experimental group to control the motor path. This appears clearly in the three rotations as the subjects of this group are distinguished by their ability of accelerating the rotation gradually from slow phase to the fast one, as a result of the positive impact of the drag stage and increase of rotation speed and control of the path of fulcra of the three rotations of the experimental group. The improvement of the heel and instep of the individual fulcrum by dragging towards the throw direction is considered a positive thing as a result of the drag and resistance stage and its effect on the duration of individual fulcrum and the total time of rotation with a great difference from the control group, and the means led to improvement in the motor balance and the control of fulcra path and distributing it positively during rotation. The means helps keep the trunk vertical and not to lean backward to face the centrifugal forces. That consequently led to increase of the preliminary speed of the hammer. For the same reasons, the kinematic variables, angle / speed and the height of experimental group, as the design of the means according to the mechanical bases of the hammer throw and its suitability to the performance technique. This, again is consistent with the validity of the second hypothesis.

Rotation is considered the most important factor that generates velocity (5). Gradual improvement is noticed from the first rotation to the third one of the experimental group, unlike the control group as there was a defect of the timing distribution, besides it increased in the final rotation. The importance of accelerating the rotation speed from a session to another is referred to, too (19). The means led to improvement in the duration of the individual and dual fulcrum through rotating on heel with the ability of controlling the balance through the device and the ability of rotating on the outer edge of the feet and loading the instep and its weight on the inner side of the insole easily, and

transition from a rotation to another without deviation on the specified path (6).

The means also led to positive improvement of distribution between the form of individual and dual fulcrum (Ralph), and the speed of the individual fulcrum of the experimental group, that is cut positively inside the circle by the three rotations that have specified path by the means, participated in improving the rotation speed by the modified rotation device by using drag towards the throw direction and using the reverse drag method that affected positively on the times of fulcrum and their distribution and the rotation total speed (2) (14) and the importance of the individual fulcrum and its relation with the dual one , and the increase of rotation speed. This again is consistent with the validity of the second hypothesis.

Table 11 shows significant differences in all the variables that indicate the functional efficiency of measurement (pre and post) of the groups (control and experimental) in favour of the experimental group. This shows the efficiency of the training means, the modified rotation device with the styles of drag and resistance, during the rotation stage, as the rotational motion inside the device is turns to linear motion towards the throw direction without deviation in the motor path that specifies the effectiveness of performance, and affects the distance of distributing the fulcrum in a positive way with the goal direction to enable the thrower to be in the best position of release. This positively affects the distance of deviation away from the throw direction line, and on the specified motor path that achieves balance. This is consistent with (7) that the importance of keeping the motor balance and the flow of the different parts is based on increasing the rotation speed with maintaining the form of the individual and dual fulcrum and the effectiveness of the heel and instep motion. This is consistent with the validity of the third hypothesis.

Conclusions and Recommendations :

First : Conclusions :

Through analyzing the data, and discussing its results, the researcher was able to achieve the following conclusions :

The means of rotation device that is modified by the drag and resistance styles of the hammer throw competition that has a special characteristic of the motor performance, has a positive impact on stimulating the indicators of the vestibular system in all the measurements of the functional efficiency in favour of the experimental group used for the means.

There are significant differences between the pre-measurements and the post-measurement

of the kinematical and functional skill and physical variables and the numerical achievements of most measurements under research, of the hammer throw competition of the experimental and control groups.

The use of the means of rotation device that is modified by drag and resistance style of the hammer throw competition of the experimental group led to improvement in the kinematical variables and the numerical, physical and functional achievement of the experimental group better than the control group and with significant differences.

The use of the training programme with the modified rotation device on the experimental group led to results better than the second method of using the programme only on the control group, and that led to controlling and specifying the rotation path and improving the motor balance and speed and displacements.

Recommendations :

It is necessary to add mechanical information in the implement of the training unit in the training programme.

Using the training programme with the rotation device that is modified by drag and resistance styles of the hammer throw competition, in defining the different training loads of the hammer throwers.

Using the training programme with the rotation device that is modified by drag and resistance styles of the hammer throw competition, in the practical field and spreading it in clubs to

develop the effectiveness of motor performances, and to improve the numerical levels of the hammer throw competition.

Care for designing other motor paths in the skill direction built on mechanical bases through which the physical factors that are related to throw competitions are developed.

References

1. Sareeh Abdul Karim Al Fadly: Biomechanics Applications in Sports Training and Motor Performance, Uday Press, Baghdad, 2007
2. Aref. H..: *The effect of using a tool to adjust the movement span for the performance of rotation phase in hammer throw event for beginners* "M. Sc. Dissertation, the faculty of sports education for men, Alexandria university, 2004"
3. Bastaweesy B..: *Track and field events, training – technique – teaching* "2nd edition, EL-Fekr El-Araby press house, Cairo, 2003"
4. Cookmeagen K., Steven J.: *Muscular power and performance in the hammer throw*. "Medicine &science in sports exercise; May – volume 390- issue 5 2007"
5. Dapena.J.: *Predication of distance in hammer throwing*. "Journal of sports science vol 21, no 7 Jun 2003"
6. Dapena.J.: *A kinematical study of the centre of mass motion in the hammer throws.* "Medicine & science in sports & exercises volume 2issue ", 2009"
7. *George; Circuit training with tom patron off track coach .winter No150 .200*0
8. Gutierrez M. & Soto A.: *Biomechanical analysis of individual techniques of the hammer throw finalists in the Seville athletics world championship 1999*. "Education fisicay deportive Universidad de Granda ,Spain.2009"
9. Hans S. & Tom K.: *Biomechanics grund lagen sport licher beweguog*; "Lehrbuch der biomechanik balingen; spoittareri .2005"
10. International Handball Federation: the general development of training sessions in the hammer throwing event – Regional Development Centre, No 38, Nasr City, Cairo 2003.
11. International Handball Federation, throwing event, Egyptian Federation for track and field amateur players - Concord Press Hadaek Shoubra – cairo, 2008
12. Jaber A..: *The principles of biomechanics and its applications in the sports field* "El-Wafaa press house, 1st edition, Alexandria, 2003"
13. Jebally E.: *Track and field between theory and application* "2nd edition, El-Tayseer press house, Cairo, 2000"
14. Otto R. M.: *A kinematical analysis for Syedk's world record in hammer throw*. "Track technique No. 119, Spring 1992"
15. Rojas F.: *Predication of distance in hammer throwing*. "University of Granda, Espangne.2009"
16. Medhat Salem & Al Sowaih Al Rakeie; the effect of a suggested training Programme on performance level of junior discus throwers in the continental and marine regions in Libyan Jamaherya compared to the digital level of Egyptian juniors. Paper published in the Hague International Conference-Washington University, USA, 2009.
17. Saad Sallam, Saad Kotb, Abdel Monem Haridy and El-Sayed Shehata: Theories and applications, Track and Field Events – Part 3 Maktabet al Esha'a Al Fannya, Alexandria, 2003
18. - Sara M. & Kevin K.: *Development and validation of a method to directly measure the cable force during the hammer throw*. "Jams Cook University, Australia 2009"
19. - Thomas P: *Kinematical analysis of the hammer throws in competition*. "State University of champions. campinaz, Brazil.2009"
20. Waheed K..: *The effect of using the release flying curve on the way of releasing the hammer for beginners*. "PhD dissertation – the faculty of sports education for men – Alexandria University, 2003