Guided exercises in the light of biomechanical analysis to develop the skill of basket to handstand on the parallelepiped machine

Mohammed Abdullatif Abdulhadi Alsayed

*** Lecturer, Department of Theories and Applications of Gymnastics, Exercise and Sports Performances – Faculty of Physical Education – University of Sadat City**

Introduction and importance of research :

Gymnastics has received great attention from biomechanics scientists after the remarkable development in the world and Olympic championships, and the development and development of a large number of motor skills of high difficulty on various devices, which led to the need for mechanical analysis of those skills (2:11).

Gymnastics is a fertile field for biomechanical analysis, including multiple motor skills performed on all axes and levels, and its devices are characterized by stability, which leads to easy analysis of its various skills.

Biomechanical information is the best way to achieve the goal of movement, it helps us to detect errors in performance and is a way to find ways to improve skill performance (7:125).

The study of biomechanical indicators is one of the basic research in the study of movements and knowledge of the factors affecting them, and therefore modern research in the sports field has tended to study biomechanical indicators of some motor skills and develop quantitative and objective standards for them, with the aim of improving the level of skill performance (52:2).

Perhaps one of the objectives of science in physical education is to identify important mechanical variables, for motor skills and causing excellence in sports competitions, and it is known to researchers that performance in all sports is associated with a specific set of basic mechanical variables, each of which has a degree of importance for this activity (15:14).

The parallel device for men is one of the most important basic devices in the competition program for various gymnastics championships, whether local or international, and is considered from the researcher's point of view one of the most important and difficult six devices, due to the diversity of groups on it (5) kinetic groups :

1- Weighting skills by focusing on the two crossbars.
2- Skills weighted through brachial pivot.
3- Swinging skills by attaching to the two models together.
4- Strength and stability skills, leg weights and lateral movements on one crossbar.
5- Endings Skills (:13).

Description of the parallel exercise:

The exercise performed on the device consists of weights and flight movements of all motor groups existing or stipulated by international law and these skills are performed continuously moving between the pivot and attachment in order to reflect the full potential of the device.

The skill of the circular cupping to stand on the hands is one of the most important skills of modern gymnastics and the device parallels (the fourth group), where its performance in gymnastics has spread significantly in the recent world championships and the diversity between the ways of its performance to take advantage of the different degrees of difficulty, which in turn leads to upgrading the degree of the motor sentence performed, which leads to their entry into competition for medals device, and the intervention of the skill performed under the name of difficulty (d), the researcher has chosen this skill for its importance and the player's access when performing it on (0.4) of The degree in difficulty (D) and when it develops to difficulty (E), that is, its performance with half a lap gets (0.5) of the degree and when performed with a full lap (F) gets (0.6) of the degree and also gets the value of this special requirement and its value (0.5) of the total degree of difficulties, which is (2.5) of the degree, according to the classifications of international arbitration for gymnastics (2006-2021) (13 :).

The researcher has noted, despite the importance of the skill, the lack of sufficient information about the structural structure of it in the different stages and also the lack of obstruction of the time division of the skill, displacements and their horizontal and vertical compounds of the center of gravity of the body, speeds and their horizontal and vertical

components of the center of gravity of the body, the angular velocity of the center of gravity of the body during the different stages of performance, the amount of horizontal and vertical movement of the center of gravity of the body during the various stages of performance and the description of the ideal technical performance represents a solution to the problem of movement posed (301:3) and can be relied upon On the mathematical technique of high-level players as a standard model when evaluating skill performance (237:4)(8:1)(97:12) The mechanical dimension is one of the most important dimensions of evaluating motor performance and this dimension is crystallized in the clear approach to biomechanical analysis characterized by objectivity in the evaluation of its dependence on quantitative variables in the first place and the study of kinematic and kinetic properties of performance, which contributes to the improvement and development of this motor performance (232:16) and therefore it can be said that this research contributes positively to the process of teaching and developing the skill under research On the one hand, it also leads to help spread when the Egyptian player, which reflects positively on the level of motor sentences that perform, which prompted the researcher to study this skill in a sound scientific manner through analysis to identify the biomechanical characteristics of its performance as well as a description to develop the appropriate program to raise the level of the Egyptian player.

Research Objective:

This research aims to identify " guided exercises in the light of biokinematic analysis to develop the skill of circular pronation to stand on the hands on the parallels device.

From the above, it can be said that this research is an attempt to contribute to the development of the performance of the skill under research because the researcher found the global importance of this skill and the shortcomings among the Egyptian players, through several exploratory studies carried out by the researcher during the 2021 World Championship, the Republic Championship 20 22, and the results were as follows:

World Championship 2019

Table (1)

Miscellaneous Skill / Number of players	From the bottom to the balance	From the bottom to the balance half	From balance to balance	From balance to half
10	–	3	8	6
Performance Percentage	Zero %	30%	80%	60%

The performance of 100% of the players of the skill in question is evident in their sentences.

World Championship 2020

Table (2)

Miscellaneous Skill / Number of players	From the bottom to the balance	From the bottom to the balance half	From balance to balance	From balance to half
10	–	3	10	7
Performance Percentage	Zero %	30%	100%	70%

The performance of 100% of the players of the skill in question is evident in their sentences.

An exploratory study in the 2022 World Championship (the best eight players on the parallel device).

Table (3)

Miscellaneous Skill / Number of players	From the bottom to the balance	From the bottom to the balance half	From balance to balance	From balance to half
8	zero	1	8	4
Performance Percentage	Zero %	12.5%	100%	50%

The performance of all players of the skill in question is evident.

The researcher also conducted an exploratory study in the Republic Championship for the first class in 2021, and the number of participating players was 24 players, of whom he performed his sentence on the parallel device 19 players, and their result in skill performance was as follows:

Table (4)

Skill / Number of players	Perform the skill	He did not perform the skill
19	1	18
Percentage	5.26%	94.74%

It is clear from this table that 18 players do not perform the skill and only one player performs it.

The researcher has divided the skill through his experience in the field of training since 1987 until now into three stages:

1- The first stage (introductory) starts from handstanding until reaching the inverted attachment below the parallels.
2- The second stage (basic), which is weighting the shoulder from the bottom of the parallels until climbing above the parallels and leaving the crossbar.
3- The third (final) stage is to re-arrest the two models again and reach proper handstanding.

Research Areas:
(temporal, spatial, human)

Pictures of one of the first-class players at Sporting Club when he performed this skill for (10) attempts on 10/25/2021 at the gymnastics hall at Cairo Sports Club using a video camera, then the best attempt was chosen by a committee of international arbitrators accredited by the records of the Egyptian Gymnastics Federation headed by an international referee for biomechanical analysis.

Data Collection Tools:

1- Digital video camera brand (SONY) DCR - TRV230E video signal colors PAL , lens zoom automatic 25 times optical 700 times digital.
2- Arbitration to determine the level of performance of the skill under research in grades.
3- A medical scale calibrated to measure the player's weight in kilograms (60).
4- Restameter to measure the player's height in cm (164.5).
5- Player age at the time of filming in the year (21.2).
6- Real-time computer analysis system for video tapes transferred to C.D. CDs.

Imaging and analysis procedures:

The player filmed the research sample during the performance of the skill of the Abstart Roll Balance of handstanding on the device parallel using the camera that was previously referred to, according to what was reported by Adel Abdel Basir on the procedures of scientific video photography has considered the researcher mechanical model of the player's body consists of (14) hard link according to the model of Prinstein 1967 for Adel Abdel Basir on 1998 (151:8) The camera was placed at the same height as the crossbar of the device parallels (170) cm and the distance of the device from the camera (10.30 m so that the optical axis of the lens is perpendicular to the spatial plane of performance, which is the lateral plane.

Signs were placed for reference when performing the kinetic analysis process on the following joints: (wrist of the hand, elbow, shoulder, pelvis, knee, wrist of the leg) on the side facing the camera, i.e. the imaging process. The film was analyzed to perform the skill under research and included the analysis cadres, which reached (66) cadres.

They were divided by the researcher's experience into three stages:

- Introductory stage.
- A major stage.
- Final stage.

The following was extracted through the process of analyzing the skill in question :

- Time division of the skill and time of the skill
- Stage table (phase, whom, percentage, time).
- Displacements and their horizontal and vertical components of the center of gravity of the body.
- Speeds and their horizontal and vertical components of the center of gravity of the body.
- The angular velocity of the center of gravity of the body during the different stages of performance.
- Horizontal and vertical thrust of the body's center of gravity for different performance stages.

Program Design:

After the kinetic analysis of the skill under research and after referring to the references specialized in the field of training and gymnastics (Mohammed Hassan Allawi 1994) and with the help of the experience of specialists and the personal experience of the researcher as a coach and referee has been the development of educational steps that are similar to the nature of performance in terms of speed of performance, time and nature of muscular work. As for the time of each exercise, the time of the training unit was divided by the number of exercises in the training unit (4:) As for the number of repetitions for each exercise, it was determined by dividing the largest number of repetitions by 2 during the time prepared for each exercise, and the rest period was recorded between each exercise and the next exercise, taking the pulse as a criterion to determine the average of this time (235:9) and this resulted in the following:

- The average rest time between the repetitions of each exercise is (45) s.
- The rest time (transition) between each new exercise is (45) s at the moment when the average pulse reaches (120-130) beats / s.
- The time of the training unit is approximately (70) s distributed as follows:

(15) minutes of warm-up, (30) minutes of training on educational steps (20) minutes of skills (5) minutes of calm and conclusion.
Attachment(1)

Foundations of the program:

- The program is developed to be consistent with low-intensity interval training, by forming physical load and rest so that the intensity reaches (50%: 60%) approximately. Annex (1)
- The program is implemented in the form of training units up to (12) training units for a month, i.e. three training units per week.
- Taking into account the gradual rise of the degree of load, and the correct timing to repeat the exercise and continue it after taking the rest between them.
- Use of multiple devices and auxiliary tools.
- Using the bond with the player fixed in the movement knot, and during performance on assistive devices to improve the level of performance.

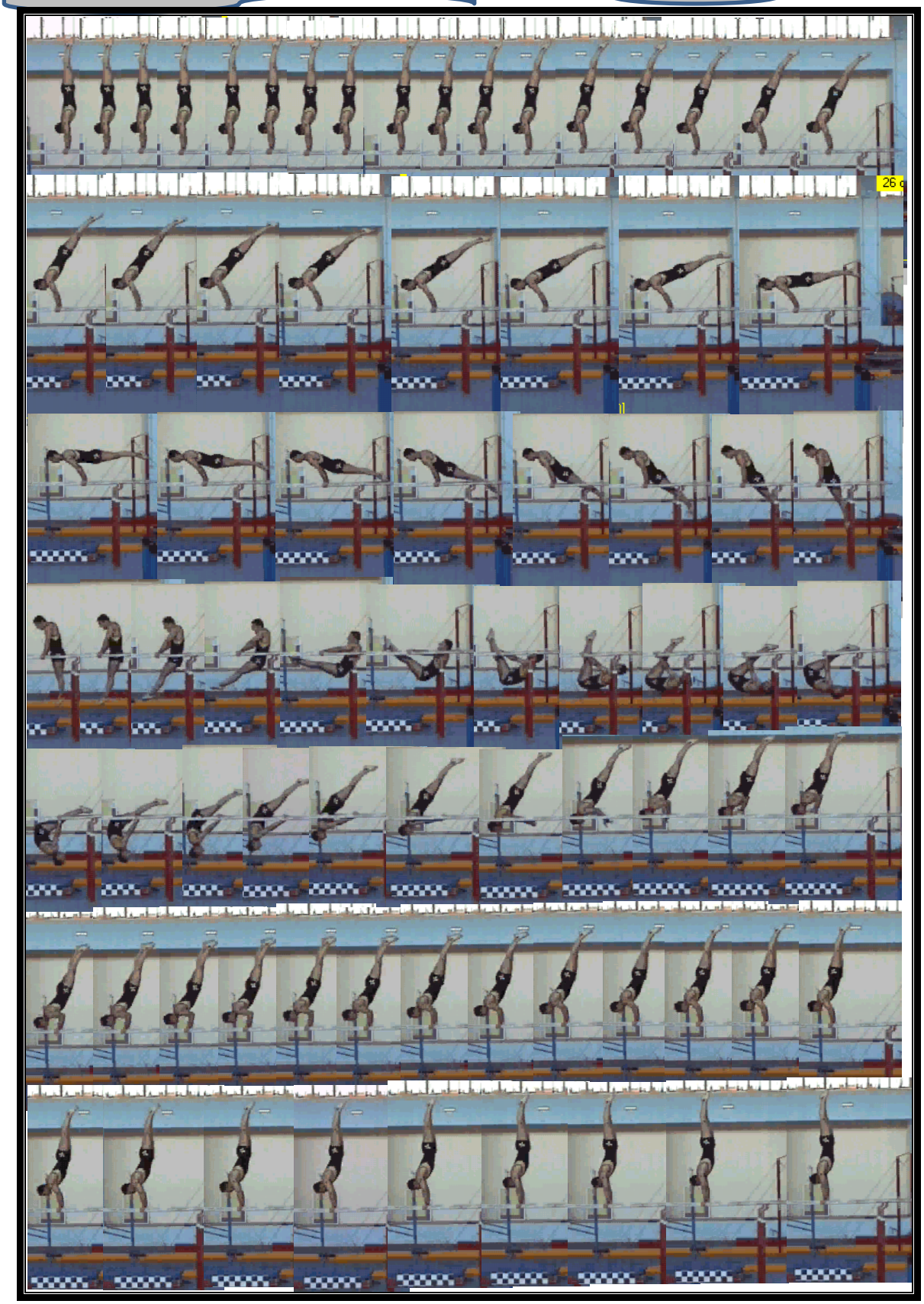


Figure (2) Successive cadres of the skill under research

Presentation and discussion of results:

Figure (3) Chronogram with time division of skill performance stages

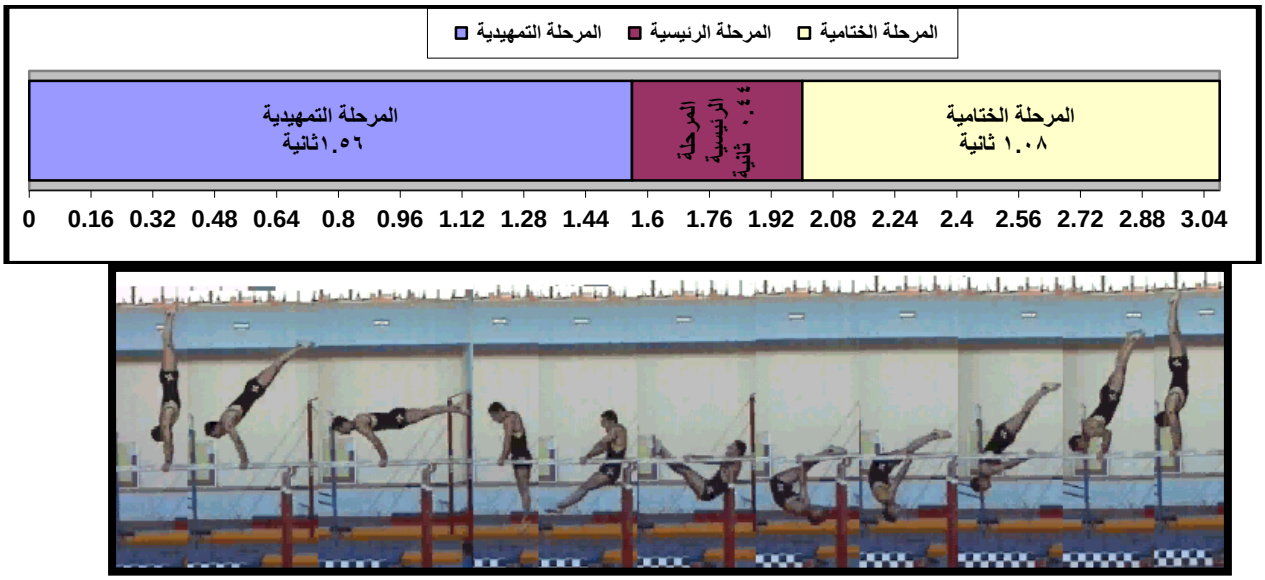


Table (5)

Temporal structure of the stages of technical performance of the skill

Stage name	Number of cadres	Time (w)	Percentage (%)
Introductory stage	40	1.56	50.65
Main stage	11	0.48	15.58
Final stage	27	0.04	33.77
Total	78	3.08	100

It is clear to us from Table (5) and Figure (3) for chronograms and the time division of the stages of skill performance that the first part of the skill, which is the preliminary stage, has taken a time of (1.2) seconds and by (46.154%) of the total time of the skill and the researcher sees the length of this period because it is a very important stage and has many technical aspects such as slowly descending from handstanding and then pushing the farmers to return the shoulder joint back to gain speed to facilitate the process of performing the skill, the main stage Which was the time (0.44) s and represented a percentage of (16.923%) of the total time of the skill because it is a small stage and is characterized by speed and that the descent of the body in the direction of the work of the ground jazzzi, while the final stage is characterized by the presence of technical aspects such as pushing the farmers against the direction of the body and

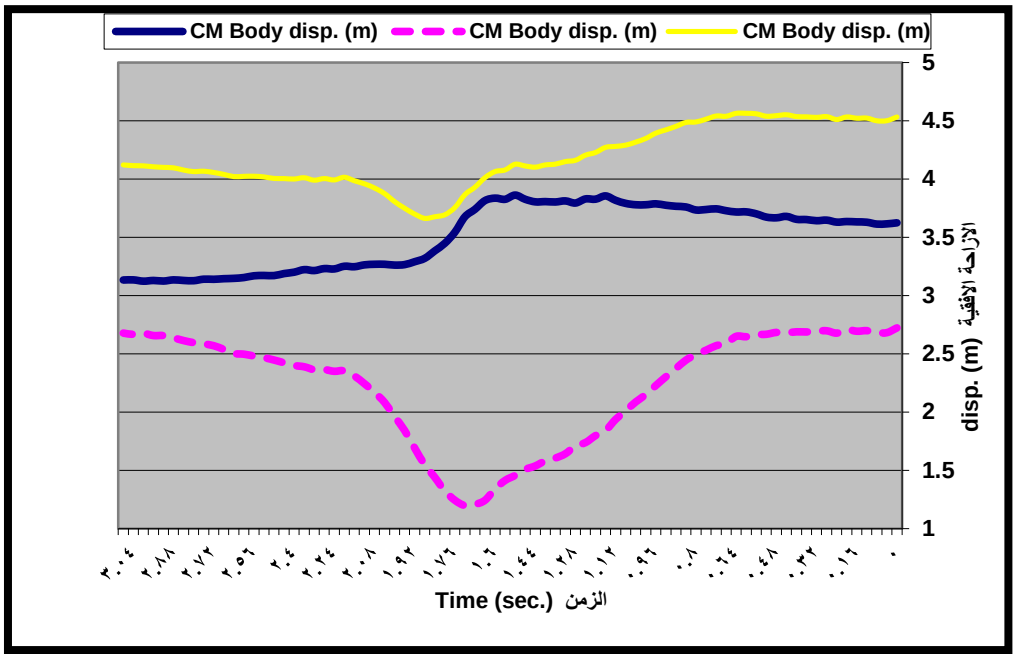
also the stage of flight and then re-capture the crossbars of the device and also the direction of the body is going in the direction of the opposite direction of the ground jazzzi and therefore its time was (0.96) s and by (36.923%) of the total time of the skill, which took (2.60) d.

Table (6)

Horizontal and vertical displacement and the resultant displacement of the center of gravity of the body during different stages of performance

Stage	Staff Number	Time	Displacement Horizontal	Displacement Vertical	Outcome Displacement
		[s]	[m]	[m]	[m]
Getting off handstanding	8	0.32	3.718	2.65	4.565
Horizontal Pivot Mode	17	0.68	3.78	2.15	4.349
Vertical Pivot Mode	25	1.0	3.813	1.642	4.151
The stage of pushing the farmers	39	1.56	3.32	1.548	3.663
Flight Phase	43	1.72	3.269	2.083	3.876
Preparing for handstand	52	2.08	3.201	2.4	4.001
Handstand	66	2.6	3.13	2.657	4.106

Figure (4) Horizontal and vertical displacement and the net displacement of the center of gravity of the body during the different stages of performance

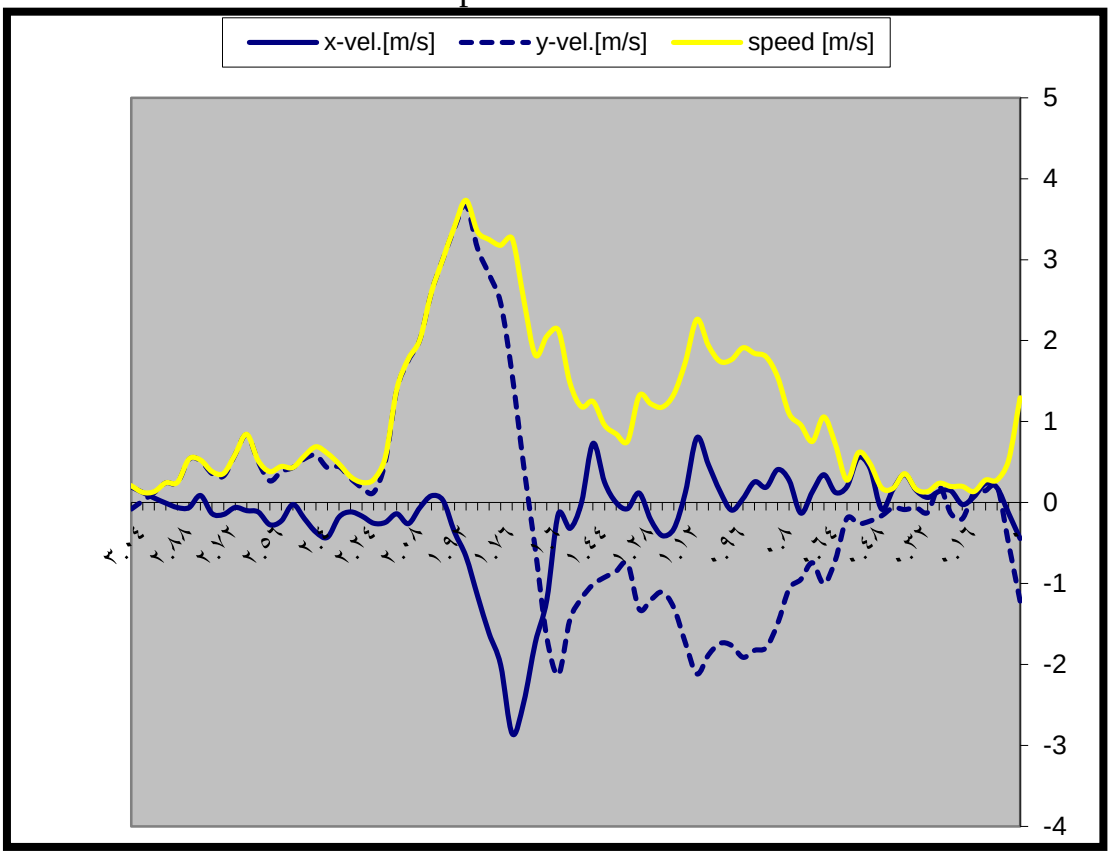


It is clear to us from Table No. (6) and Figure No. (4) on horizontal and vertical displacement and the result of the displacement of the center of gravity of the body during the different stages of performance that in the stage of descent from handstanding represented the largest displacement of the center of gravity of the body (4.565) m / s, because the technical performance in this part necessitates pressure on the farmers to achieve an appropriate speed exploited using body weight and also descend with a wheel towards the ground jazzis gradually decreased after that this displacement of the body's approach to The vertical line and the work of flexion in the pelvic joint in order to maintain the speed and reached in the position of vertical attachment to (4.151) and I also said where the displacement in the cadre (39) to (3.663) and then began to rise gradually after the tide in the pelvic joint and push the farmers to reach (4.106) before the stage of handstanding.

Table (7)
Horizontal and vertical velocity and the resultant velocity of the center of gravity of the body during different stages of performance

Stage	Staff Number	Time	Speed Horizontal	A speed Vertical	Resultant speed
			[m/s]	[m/s]	[m/s]
Getting off handstanding	8	0.32	0.13	-0.71	0.72
Horizontal Pivot Mode	17	0.68	-0.09	-1.76	1.77
Vertical Pivot Mode	25	1.0	0.12	-1.32	1.32
The stage of pushing the farmers	39	1.56	-1.15	3.14	3.34
Flight Phase	43	1.72	0.08	2.59	2.60
Preparing for handstand	52	2.08	0.43	0.43	0.61
Handstand	66	2.60	0.01	0.24	0.24

Figure (5) Horizontal and vertical velocity and the resultant velocity of the center of gravity of the body during the different stages of performance

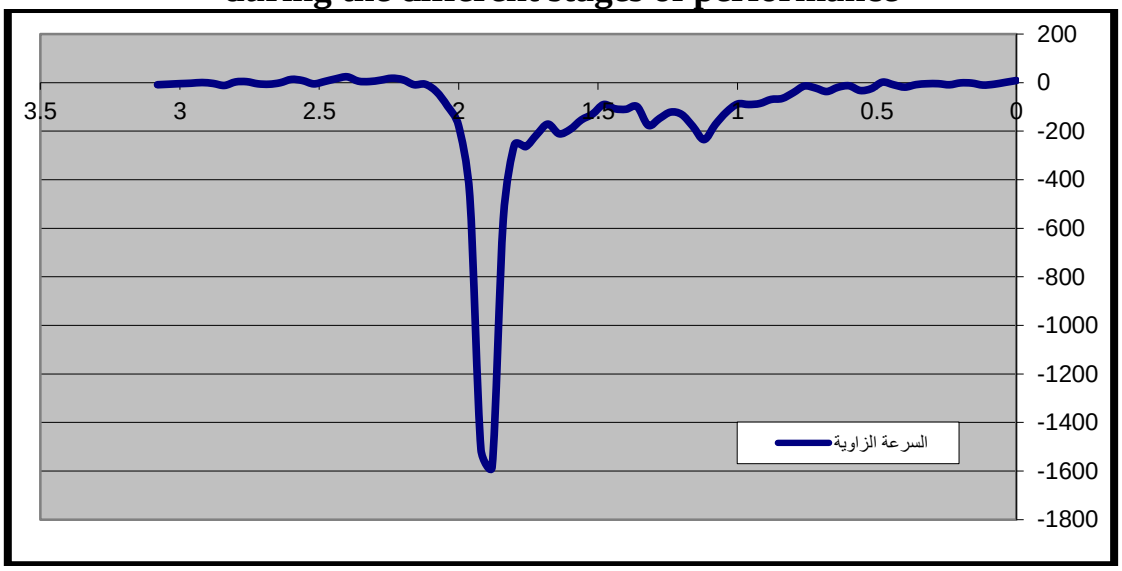


It is clear to us from Table No. (7) on vertical and horizontal speed and the resultant speed of the center of gravity of the body for the different stages of performance that the sum of speed in cadre No. (8) (getting off the handstand) reached (0.72) m / s and then the speed in Cadre No. (17) (horizontal pivot mode) rose to (1.77) m / s and this indicates an increase in the speed result because the body descended under the control of the player, but in the direction of gravity and therefore the speed rose and was also increased Even the cadre (39), which is the stage of pushing the farmers and reached its maximum speed and reached (3.34) m / s and then began to descend gradually despite the payment of the farmers and the movement of the extension of the basin, but the body at this moment was moving up against the wheel of gravity of the ground I said gradually until it reached (0.24) m / s when reaching to stand on the hands before stability in the final position.

Table (8)
The angular velocity of the center of gravity of the body during different stages of performance

Stage	Staff Number	Time	Angular velocity [deg/s]
Getting off handstanding	8	0.32	19.56
Horizontal Pivot Mode	17	0.68	-88.46
Vertical Pivot Mode	25	1.0	-176.2
The stage of pushing the farmers	39	1.56	-158. 3
Flight Phase	43	1.72	-96.96
Preparing for handstand	52	2.08	-23.75
Handstand	66	2.60	2.753

Figure (6) The angular velocity of the center of gravity of the body during the different stages of performance



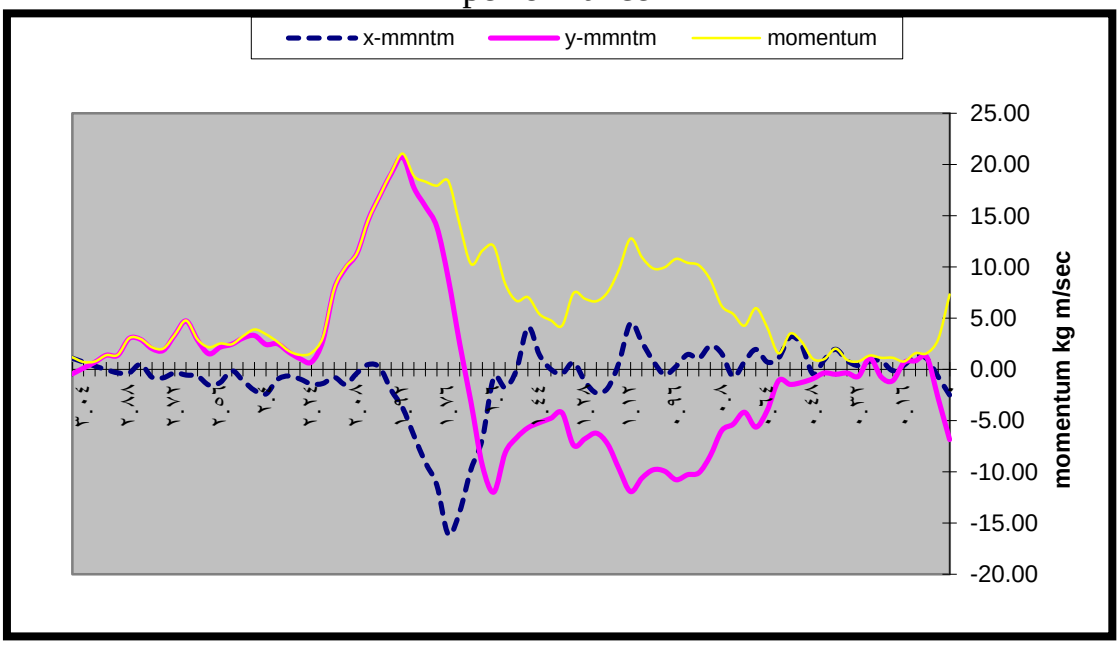
It is clear from Table (8) and Figure (6) of the angular velocity of the center of gravity of the body during the different stages of performance that the angular velocity during cadre No. (8) reached (19.56) degrees / s and increased until it reached (88.46) degrees / s in cadre No. (17) and for the horizontal pivot mode and then increased and reached its maximum amount in cadre No. (25) and this indicates that the angle of the center of gravity is at the farthest point so that the player can increase his speed until it reached (176.2) degrees / Then it began to gradually decrease in the cadre (39) when the center of gravity began to approach the vertical line until it reached (2.793) degrees / s in cadre No. (66).

Table (9)

Horizontal and vertical momentum and the net momentum of the body's center of gravity during different stages of performance

Stage	Staff Number	Time	Horizontal momentum [kg m/s]	Vertical momentum [kg m/s]	Resultant momentum [kg m/s]
Getting off handstanding	8	0.32	0.71	-4	4.06
Horizontal Pivot Mode	17	0.68	-0.52	-9.95	9.97
Vertical Pivot Mode	25	1.0	0.66	-7.42	7.45
The stage of pushing the farmers	39	1.56	-6.5	17.71	18.87
Flight Phase	43	1.72	0.47	14.64	14.64
Preparing for handstand	52	2.08	2.41	2.43	3.42
Handstand	66	2.60	0.04	1.38	1.38

Figure (7) Horizontal and vertical momentum and the net momentum of the center of gravity of the body during the different stages of performance



It is clear from Table No. (9) on the amount of horizontal and vertical movement and the sum of the amount of movement to the center of gravity of the body during the different stages of performance that the amount of movement to the center of gravity of the body during the kinetic path of the skill has gradually increased to reach its button in cadre No. (39) where it reached (18.87) kg m / s in the basic stage and then gradually decreased also to reach (1.38) in cadre No. (66) ie in the final stage and where the mass of the player is a fixed amount during Performance, the speed has a pivotal role in influencing the amounts of

movement and the researcher believes that landing with a slight curvature and with gravity leads to the increase referred to, while the third part is by extending the bending and also be against the wheel of gravity and therefore the amount of movement decreases to reach its lowest rate in the cadre (66) and it must be clarified that the technical performance of the preliminary stage, during which the player works to extend his body to increase his speed during the landing stage, which works with gravity and then uses The weighting resulting from the bending of the pelvic joint and its extension quickly in order to climb against the resistance of gravity and this is explained and confirmed by the large horizontal vehicle when the cadre is (39) during the descent, which amounted to (6.5) kg m / s, as well as the main vehicle is relatively large for the amount of movement in the cadre No. (39), which amounted to (17.71) kg m / s and a total of (18.87) kg m / s at the same cadre

Based on the results of the analysis obtained, the researcher developed the following technical guidelines:

Technical performance of the skill:

The skill starts from the handstand position and then the player descends freely from this position controlling the movement of the body from the shoulder joint because when he controls his speed it is easy for him to carry out the following duties, which are in the horizontal position he pushes the body back and opens the corner of the shoulder joint with a slight curvature in the back to try to increase control the work of the back muscles and then makes a quick bend in the hip joint until it becomes in the position of inverted attachment begins to make a rapid tide In the hip joint and followed by the work of opening the shoulder joint by pressing the crossbar of the device parallel and completes this push up to the angle of 45 top parallel and then the flight and re-capture properly to reach the position of handstand .the researcher has taken into account these stages well in the development of the training program consisting of (12) training unit attached (1), which contained exercises qualitative graded based mainly on the results of the skill analysis of the skill of the circular pronation of the fulcrum to stand on the hands on the device parallels.

Recommendations:

In light of the current research results, the **researcher recommends all workers in the sports field, especially coaches, the following:**

1. Taking into account the following elements when preparing and developing methods of teaching and training the skill of circular pronation to stand on the hands on the parallel device:

A - time division, angles and joints of the body during the skill under study

B - Biodynamic characteristics in the stages of performance of the skill under research

C - Development of strength characteristic of speed of muscle groups working on the joints of the shoulders and thighs

2. Using the skill program to teach young players because of the great importance of this skill

3. Conduct similar research on other skills with a high legal assessment

References:

1- Jamal Mohammed Alaa El-Din: Biomechanical Introduction to Evaluate Proficiency in Skill Performance in the Sports Field (Theoretical Study, Postgraduate Studies, Faculty of Physical Education for Boys in Alexandria, Helwan University, 1981, p. 8

2-————————: Laboratory study in biomechanics of sports movements, Alexandria, 1994.

3- Gerd Hochmuth: Biomechanics and Scientific Research Methods for Mathematical Movements, translated by Gamal Abdel Hamid, Dar Al-Maaref, 1978, p. 301

4- Hosni Sayed Ahmed Hussein: A proposed program using educational technology and its impact on the development of some special physical qualities and the speed of learning for the skill of the American scissors (Thomas) on the throat horse, published research, Journal of theories and applications of the Faculty of Physical Education for Boys, 2004

5- Hosni Sayed Ahmed Hussein: Mohab Abdul Razzaq Ahmed Analysis of differentiation between high level and normal level players in the biomechanical characteristics of the technical stages of the skill of the curly aerobic cycle, on the parallel beam, published research, Journal of Science and Arts, Faculty of Sports Education for Girls, Al-Gezira, Cairo, 2004.

6- Hanafi Mahmoud Mukhtar: Scientific Foundations in Football Training, Dar Al-Fikr Al-Arabi, 1995, p. 26.

7- Sawsan Abdel Moneim: Others Mechanical Foundations and Technical Groups for Gymnastics, Dar Al-Maaref, Egypt, 1977, p. 125.

8- Adel Abdul Basir on: Biomechanics and integration between theory and practice in the sports field, second edition, Book and Publishing Center, Cairo, p. (151) (159161).

9- Mohammed Hassan Allawi: The Science of Athletic Training, Ninth Edition, Dar Al-Maaref, Cairo, 1994.

10- Mohamed Mahmoud Abdel Salam: Technical Performance and Educational Steps for Throat and Parallel Horse Exercises, Dar Al-Maaref, Alexandria, 1978.

11- Mohab Abdul Razzaq Ahmed: The effect of developing perception "kinesthetic" on the level of performance of the posterior pelvic circle to stand on the hands on the mind device for gymnasts under 12 years, unpublished master's thesis, Faculty of Physical Education for Boys, Alexandria University, 1988.p. 2

12-Dillman c.j.,cheetham,p.j.,and Smith,s.l.	Akinematic analysis of men's Olympic long horse vaulting international journal of sport biomechanics, may, 1985, peg 97.
13- Men's artistic gymnastic	International gymnastic federation code of points, new version, 2006.
14-Pollok.,Jackson ,A,&Pot	Discriminat analysis of physical differences betmeen good and elite sport ,1980 peg 15
15-Tikhonov,v.n.	Improvement of vaulting technique iin gymnastics biomechanics of sports and kinanthrapometry symposia specialists .Inc.,1978.peg 237
16-Verducci,f.mf	Measurement conserts in physical education ,c.v. mosley company ,sant louis, 1980 peg 232.