The Kinematic Variables of Elite Egyptian Hammer Throwers Performance

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Abstract :

The research aimed to know The Kinematic Variables of Elite Egyptian HammerThrowers Performance,researcher used a descriptive approach based on kinetic analysis and the use of three-dimensional imaging, The research sample was selected deliberately and was represented by three male contestants under the age of (20) registered with the Egyptian Athletics Federation.

Conclusions of the resarch was ensuring the gradient in the decrease of rotation is from the first rotation to the third only and that the time of the fourth rotation is higher than the third,the double anchoring time of the first and second player was better than the third player, while the third rotation was less, and the search sample numbers in the double anchoring were close due to the importance of the double pivot stage during rotation in that it is the part where contact with the ground is made and the body gains speed during the single pivot of the second stage, the more the pivot is more positive, the more the rotation speed increases in general,the excessive decrease in the double pivot time of the third player during the turns from the first and second player indicates his inability to control the rest of the turns due to the reduced ability to control the individual pivot,the use of kinematic analysis in the hammer knock-out competition helps to identify weaknesses and strengths in skill performance, which helps players improve their level and achieve the highest digital level.

المتغيرات الكينماتيكية للاعبين اطاحة المطرقة المصريين

الملخص :

يهدف البحث الي معرف المتغيرات الحركية لمتسابقي اطاحه المطرقة المصريين, استخدمت الباحثة المنهج الوصفي القائم على التحليل الحركي واستخدام التصوير ثلاثي الابعاد ،تم اختيار عينه البحث بطريقه العمدية وتمثلت في ثلاث متسابقين رجال تحت ٢٠ سنه المسجلين بالاتحاد المصري لألعاب القوي، واستنتجت الباحثة انه يجب التأكيد على ان يكون التدرج في انخفاض الدوران من الدوران الاول حتى الثالث فقط وان يكون زمن الدوران الرابع اعلي من الثالث, كان زمن الارتكاز الزوجي للاعب الاول والثاني افضل من اللاعب الثالث بينما الدوران الثالث كان اقل وكانت ارقام عينه البحث في الارتكاز الزوجي متقاربه ويرجع ذلك الى اهميه مرحله الارتكاز الزوجي اثناء الدوران في انه الجزء الذي يتم فيه الاتصال بالأرض والدفع الاكساب الجسم سرعه خلال الارتكاز الفردي للمرحلة الثانية فكلما كان الارتكاز اكثر ايجابيا ادى زياده سرعه الدوران بشكل عام, ويشير الانخفاض الزائد لزمن الارتكاز الزوجي للاعب الثالث خلال الدورانات عن اللاعب الاول والثاني الى عدم قدرته على السيطرة على باقي الدورانان ويرجع ذلك الى انخفاض القدرة في التحكم في الارتكاز الفردي,ان استخدام التحليل الكينماتيك في مسابقه اطاحه المطرقة يساعد على التعرف على نواحي الضعف والقوه في الاداء المهارى مما يساعد اللاعبين في تحسين مستواهم وتحقيق اعلى مستوى رقمي.

The Kinematic Variables of Elite Egyptian Hammer Throwers Performance

In light of modern progress and modern technology, sports training is developing in general, and this is centered on elite players in particular, and from sports in which the extent of technical and record development is manifested, and the sport of (field and track competitions) continues its rapid progress, and its global brilliance in all kinds of competitions from running, jumping, jumping and throwing, although field and track competitions look natural and easy to perform in general, but in fact they are very precise and tainted with complexity in many cases, so we urgently need clarification and simplification of field and track technique. It is one of the ancient sports, it is

the nerve and Bride of the ancient and modern Olympic Games, and it is sometimes known as the mother of other sports, and some consider progress in it a measure of the civilization of peoples, as well as it instills in its practitioners good manners and good qualities in addition to physical and skill integration, an organized sport governed by accurate measurement by meter and hour, according to its various divisions.

That the mastery and completeness of sport movements depends on the extent of coordination and compatibility of the forces causing these movements, and that the forces in their influence together can support or hinder each other. (5:629)

Bartonietz (2000) points out that the evaluation of any motor performance is carried out through three main dimensions, namely (psychological dimension, physiological dimension and mechanical dimension), the most important of which is the mechanical dimension because of its objectivity in the evaluation of its reliance on objective methods of measuring distances, times and forces acting in digital form, which raises its objectivity and truthfulness in the evaluation, and the study of mechanical properties provides the opportunity to objectively judge the level of mastery of performance for training theories.(٣:٤٥٩)

Talha Hussein hossam eldin et al. (1998) also affirms that biomechanics is at the forefront of the sciences that are concerned with the study and analysis of motor performance in order to study the indicators and characteristics of human movement to detect motor performance, but it contributes significantly to assessing the effectiveness of various training methods and means in terms of the player's mechanical return from the physical point of view, motor performance from the skill point of view and the level of record achievement. (10:124)

The hammer competition is considered one of the most difficult and complex competitions in the field, due to the nature of the technical performance, which requires the use of all different parts of the body forces in order to accelerate to the maximum angular velocity at the moment of launch, and the performance begins by performing preliminary swings and then entering into three or four rotations in order to gradually increase the speed of performance at the moment of launch.(1:69),(11:127),(7:228)

Achieving the best possible distance by being able to reach the hammer with the highest possible speed and at an appropriate angle at the moment of its launch, where the performance speed increases gradually during the double anchoring (pushing the ground) and single anchoring (rotation) during each rotation, where the hammer rises to the highest point during the single anchoring while decreasing to the lowest level during the double anchoring.(1:71-80)

Research objective:

The research main objective was to identify the performance kinematic of Elite Egyptian Hammer Throwers

Research questions:

What are the kinematic variables of Elite Egyptian Hammer Throwers performance?

Search procedures:

First: research methodology:

The researcher used a descriptive approach based on kinetic analysis and the use of three-dimensional imaging

Second: the research sample :

The research sample was selected deliberately and was represented by three male contestants under the age of (20) registered with the Egyptian Athletics Federation

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Table (1) shows the record level, anthropometric measurements and the training age of the research sample in the hammer throwing competition

Names	Digital Leve	Weight	Height	Training Age
Adhm Mohamed	66.22 cm	90 kg	186cm	5 years
Abdullah Mohamed	64.50 cm	104 kg	185 cm	5 years
Moaz shafek	58.55 cm	98 kg	182 cm	5 years

Data collecting tools

High frequency video cameras and inertial motion sensors:

Motion tracking was carried out using inertial sensors in conjunction with high-frequency imaging using the following instruments and devices:

- Perception neuron pro motion sensor.
- Bob's motor analysis program " biomechanics of bodies":

It was created and developed using the MATLAB platform and developed using Math Works, which processes the input data from various means and tools of motion imaging to process and analyze them and then give quantitative and descriptive outputs in a digital image, a graphic image, or both, depending on the output; it also assigns angle values either relative to the global co-ordinate global coordinate grid or the local coordinate grid.

- Cameras (SoCoo/ C30 S High Speed Camera), set to a frequency of(60)frame/ s, and with a shooting quality of (1920*1080) pixels.
- tripods equipped with a water balance.
- Remote (SoCoo) for synchronizing cameras) (Wireless Sync remote.
- Laptop computer (HP Pavilion G6.
- A tape measure.

Survey study to adjust the search procedures:

The survey was conducted on Wednesday, 28/12/2022 at exactly five o'clock.

The purpose of the study :

Identify and adjust the places of installation of cameras so that they are perpendicular to the middle of the field of movement.

Study results :

- Installing cameras outside the throwing cage at a distance of (8m) from the middle of the circle .
- The height of the cameras from the ground level (1.25m) the horizontal shooting field of each camera (8 m).

Imaging and analysis procedures:

- The camera was placed outside the throwing cage.
- all the contestants ' attempts were filmed and the best attempt was selected for each contestant and the kinetic analysis was performed according to the record level.

Table (2) Show the the average and the standard deviation of the rotation times for the individuals of the research sample

Variants	Measure unit	First player	Second player	third player	Average	Standard Deviation
First rotation time	Sec	0.867	0.817	0.785	0. 823	0.017
Second rotation time	Sec	0.650	0.635	0.673	0.652	0.017
third rotation time	Sec	0.551	0.516	0.617	0.561	0.024
Fourth rotation time	Sec	0.484	0.500	0.469	0.484	0.097

Table (2) and Figure (1)Show The Time of the four rotations to the gradual decrease in the rotation time of all contestants whenever the contestant moves from one rotation to the next, as well as the average times of the four rotations for the individuals of the research sample

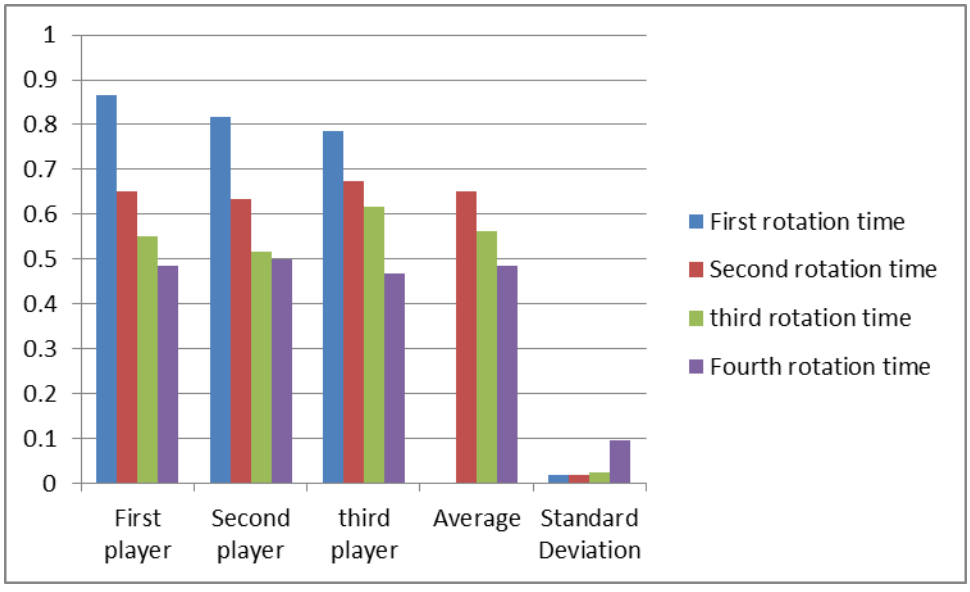

Figure (1) Show The Time of the four rotations and Average and Standard Deviation

Table (3) Show the time of double anchoring and single anchoring during the four rotations of the research sample

Variants	Rotations	Measure unit	First player	Second player	Third player	Average	Standard Deviation
Double Anchoring	First	Sec	0.316	0.408	0.467	0.397	0.076
	Second	Sec	0.417	0.367	0.358	0.381	0.032
	Third	Sec	0.291	0.233	0.283	0.269	0.031
	Fourth	Sec	0.258	0.225	0.233	0.239	0.017
Individual Anchoring	First	Sec	0.291	0.308	0.333	0.311	0.021
	Second	Sec	0.241	0.258	0.250	0.250	0.009
	Third	Sec	0.225	0.258	0.241	0.241	0.017
	Fourth	Sec	0.216	0.233	0.258	0.236	0.021

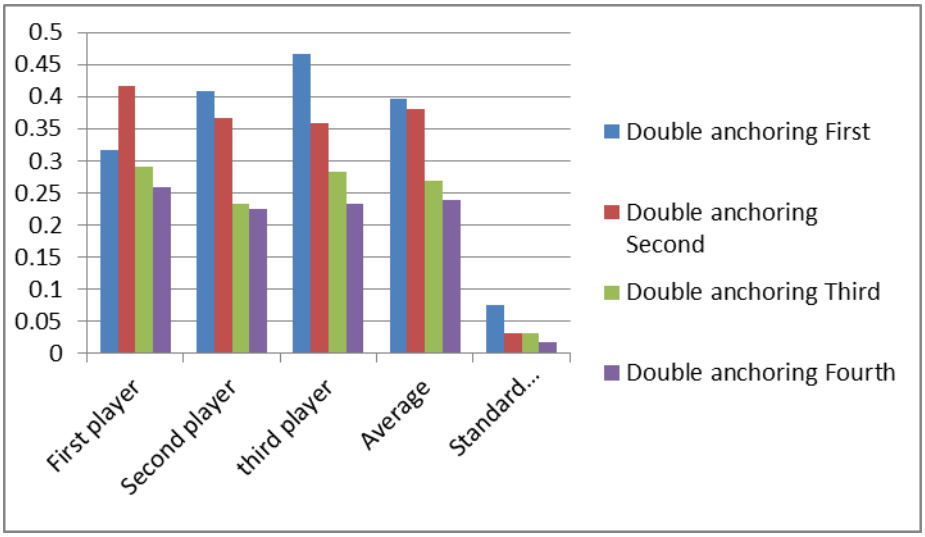

Figure (2) Show The time of double anchoring during the four rotations of the research sample

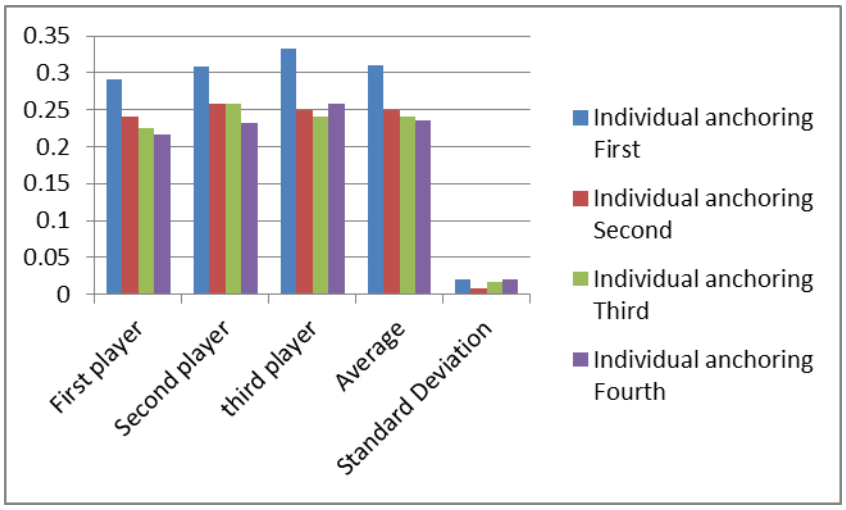

Figure (3) Show The time of single anchoring during the four rotations of the research sample

Table (4) Show release height, release speed, release angle of the research sample

Variants	third player	Scend player	First player
Rrelease speed	22.13	23.78	24.57
Rrelease angle	38.33	42.53	45.67
Rrelease height	155	162	167

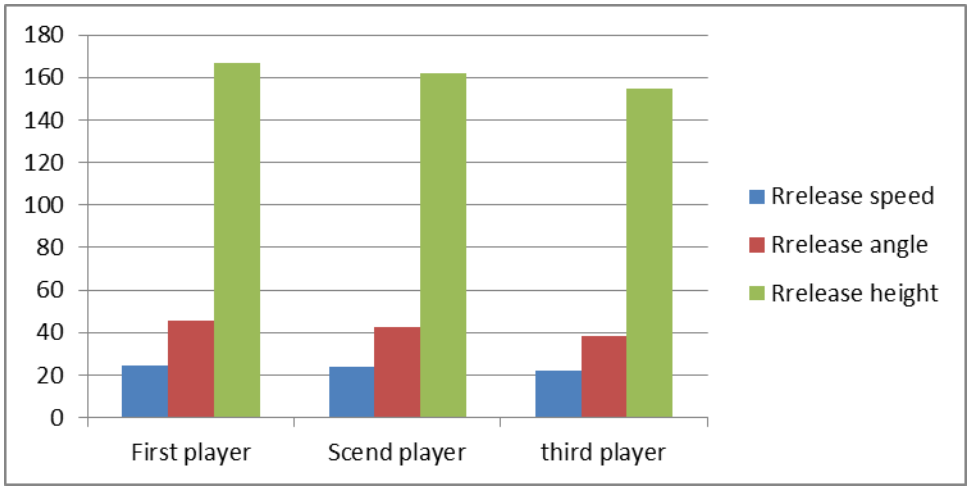

Figure (4) Show release height, release speed, release angle

Table (5) Show of the record level of of the research sample

Names	Digital Leve
Adhm Mohamed	66.22 cm
Abdullah Mohamed	64.50 cm
Moaz shafek	58.55 cm

Presentation and discussion of results:

Table (2) show the first rotation time of the first player ranges between (0.867 : 0.484) while the first rotation time of the second player ranged between (0.817 :0.500) and the third player the first rotation time ranged between (0.785 : 0.469)the average times for the three game was the highest (0.823) and the lowest (0.484)and this is evidenced by the gradient of the decrease in the rotation Times of the individuals of the research sample starting from the first rotation until the fourth rotation, and the researcher sees that the increase in the fourth rotation time and the decrease in the rotation time of the three contestants is not an advantage and not this leads to the fact that the first player has the ability to retain his physical abilities higher than the second and third player.

Table(3)and Figure (2),(3)that the average double-pivot time during the four rotations of the research samples amounted to (0.239,0.296,0.381,0.397) respectively, and the double-pivot time of the first and second player was better than the third player while the third rotation was less than the fourth rotation, the individuals of the research sample in the the more positive the focus is, the greater the rotation speed in general, resulting in an increase in the speed of rotation.

The excessive decrease in the double anchoring time of the third player during the rotation from the first and second player indicates their inability to control the rest of the rotations, as also evidenced by the gradual decrease in the single anchoring time for both the first, second and third player, but the amount of decrease shows the quality of performance, as the average range of (0.311-0 0.25,0.241-0.236)second, In order by a decrease of(0.005, 009, 0.610) seconds respectively, and thus the single pivot(negative time) tends to rotate as the player walks through it through the lifting force that he followed with his right foot during the double anchoring, and it is clear from the above

that the individuals of the research sample had the fastest rotation of the second rotation.

This is consistent with Essam Fathy Gharib(2022)(5): in the Egyptian research sample, the fastest rotation was the second rotation, while in the upper levels, the fastest rotation was the third, where there was the largest decrease in the time of the negative phase of rotation.

Talha Hussein(2009)(10)indicates that the throwing skill uses an open kinematic sequence and depends on the compatibility of the movements of the limbs within this series, so we observe the direct effect of the movement of the trunk in the shoulder girdle and thus on the throwing arm, and the torque of the rotational movement leads to a reduction in the radius of inertia of the body during rotation and leads to angular velocity and vice versa within the limits of the amount of angular movement.

Table (4) and Figure (4)show where the launch speeds of the search sample were for the first player (24.57), the second player(23.78) and the third player(22.13), the throwing height for the first player (167), the second player(162) and the third player(155) and the throwing angle for the first player (45.67), the second player (42.53)and the third player (38.33) and must be below to orbit the hammer at an angle ranging from (260 - 300), the angle of inclination of the hammer should also be during the preliminary weights, and the starting angle in the throwing position ranges from(44-43).

The researcher believes that an increase in the launch speed by 5% can result in an increase in the throwing distance by(12:7) m.

Aweys Al-Jabali (2000)(2) indicates that the hammer depends on the initial weights to a large degree to improve the biomechanical foundations, namely, the hammer is weighted with an optimal orbit with the extension of the arms as much as possible and the inclination of the trunk towards the orbit of the hammer and reduce the movement of the pelvis against the movement of the trunk, increasing the speed of the hammer each time after passing the value of its orbit.

Dapina (1989) points out that if the starting point height is fixed at (1.70) and the starting angle by (24) degrees, then increasing the starting speed

from (27 m/s) by (1 M/s) only leads to an increase in the achieved distance by (7.4) or by (5.58 m) approximately. (4 : 9)

Ratko (2020) points out that the starting angle of the hammer is not significantly affected at the record level due to the starting speed, where the starting angle of the research sample ranged between (42.7: 43.3 degrees) while at high levels it ranged between (41.4 : 44.1) degrees (8 - 46:36)

It is clear from Table (5) that the best distance was achieved for the first player because the rotation time of the hammer for four laps was better than the second and third player, and therefore the time of resting with the feet was positive and achieved higher strength and speed for a distance besides, the digital level of this player was better than the second and third player, and the speed, angle and height of starting in the sand position was appropriate with the level of rotations, supports and physical condition, which achieved the highest digital achievement of this player.

Conclusions:

1-ensuring maintain the decrease of rotation time starting from the first rotation to the third only and that the time of the fourth rotation is higher than the third.

2- the double anchoring time of the first and second player was better than the third player, while the third rotation was less, and the search sample time in the double anchoring were close due to the importance of the double pivot stage during rotation in that it is the part where contact with the ground is made and the body gains speed during the single pivot of the second stage, the more the pivot is more positive, the more the rotation speed increases in general.

3- the excessive decrease in the double pivot time of the third player during the turns from the first and second player indicates his inability to control the rest of the turns due to the reduced ability to control the single pivot.

4- the use of kinematic analysis in the hammer throw competition helps to identify weaknesses and strengths in skill performance, which helps players improve their level and achieve the highest record level

Recommendations:

1-the need to follow up the performance of the research sample by sequential analysis to monitor improvements in performance in light of the results reached.

2-the need to work to improve the starting speed of the hammer for the personnel of the research sample as much as possible by improving the control of the fourth rotation.

3-work on making the pace of the reduction of the individual recoil time greater in the second rotation so that the player can increase the speed of the third rotation and about the fourth rotation.

4-attention to achieving the motor sequence in the skill performance and the transition from the dual focus to the manager of the individual differentiation in a correct way so that it does not affect the motor performance.

5-the use of motor analysis methods that help the player achieve the highest level and adjust the motor performance of the competition

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