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Studying the Prosperities of Time- Power Curve for Sky Ball Serve 'Star Trek' Skill and its Relation to Jumping Height of the Volleyball Spikers

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Abstract

The researchers attempt to study the technical performance of the" star trek" skill both qualitatively and quantitatively in order to identify its origin and rules to help clarify these principles for the Spikers, the trainers and those who may interest in volley ball by identifying the relation between the power- time curve prosperities and jumping height during performing the star trek serve skill for the volleyball Spiker. The researcher used the descriptive approach to study the correlations and their cases as it's suitable for solving the research problem. The research sample consisted of (6) spikers of the Iraqi National Team who perform the star trek serve skill. The research sample was photographed by a Chinese (Casio) video camera with frequency (240 p/s).The (Zebris) power measuring bench was placed after the final line of the court and 10 cm from the final line off the court. It was analyzed by applying the(Kinovea) program, and the data was processed statistically by using the statistical pouch program (SPSS ver.23) After discussing the results, the most important result was a significant correlation between the mechanical variables of the power- time function (minimum landing force, the minimum landing force time, maximum hitting force, maximum bending of the knee joint of the pushing leg, the angle of the trunk at the maximum bending of the knee joint of the pushing leg, rising angle) during high jumping.

Key Words: bio-mechanical**,** kinetic analyzing, mechanical variables, time- power curve, volleyball, sky ball serve" star trek"

1- Introduction

Harnessing the biomechanics science has a great impact on improving the skill performance level of many events and sports, whether individual or collective games, such as volleyball where the responsible greatly look out for this science because it helps them in developing their spikers, as well

as, elevating their levels. Since most of this game skills are characterized by kinetic speed, it's not valid or non- objective to judge them through the naked eye or the field experience of the trainer in order to understand the skill and identify its mistakes, so the importance of mechanical analysis of kinetic skills in volleyball lies in breaking up the movement or the skill to be analyzed and studied in order to identify its kineticapraxia, and then explain the mechanical reasons for its success and failure. Success in all events and sports activities requires following up the right scientific method that achieves the goals set by trainers and experts to achieve the best breakthroughs. Volleyball is one of the games that require continuous searching and studying due to the multiplicity of its skills and the many variables that occur during matches; so it needs diversity of exercises to enable the spiker to be more proficient and more stable during performing skills. One of these skills is the star trek serve skill, which is also a basic offensive skill and the first offensive weapon in modern volleyball because of their impact on the defensive formations of the opponent team to prevent the ball from reaching the libero easily and therefore affects his offensive plans and facilitate the task of the back-row to block the balls coming from the opponent team or get a point directly. Volleyball spikers must realize that the serve is not just the ball crossing over the net but it should be performed perfectly and accurately so that they can score points through it. Therefore, the researchers decided to study and analyze this skill and identify correlations of some of its variables through kinetic and kinematic analysis to elevate to the perfect technical performance level. Thus, in this study we try to broaden the knowledge base to study the skill performance of the star trek serve skill of volleyball spikers, and to provide a new vision to improve the skill performance level through mechanical analysis. So, the researcher tries to study the technical performance of this skill to identify the bases and rules of the movement to help clarify these bases for spikers, trainers and those interested in volleyball. Full acquaintance of information related to the spiker movement, whether anatomically, mechanical, physiological or biological, is one of the key elements of the techniques success and volleyball technical skills developing. The results of tracking the movement study from a mechanical point of view contribute in remarkable progress of skills by finding kinetic solutions resulting from the perfect investment of the spiker's own self and related external forces that directly affect the skills performance. The skilled forming of the star trek serve depends on the apparent performance and external form of skill without deep understanding of the mechanical details and variables and relies on those variables to correct the errors associated with the performance of the new learners, which are often mechanical and thus acquiring skill by having skill errors in the youth stage and the stability of those errors in advanced stages, which makes it difficult to develop and modify the skill performance. Therefore, the researcher considered studying the most significant characteristics of power - time function for the spiker during performing the star trek serve skill and its impact on the jumping height during performing the star trek serve skill for volleyball spiker in order to help him identify and explain these characteristics for both trainers and spikers to be aware of their strengthens and weaknesses values to overcome them.

2- The Two Research Objectives

1- Identify the prosperities nature of time- power curve for sky ball serve" Star Trek" skill

2-Identify the relation between the prosperities of time- power curve for sky ball serve" Star Trek" skill and the high jumping during performing the star trek serve skill for the volleyball Spikers

3-Research approach and its field procedures

The researchers used the descriptive approach to study the correlations and their cases as it's suitable for solving the research problem, which means studying and deepening in the facts and the correlations between those facts, as well as, representing the relations between the facts, realities and their correlation provide descriptions of all phenomena accurately and scientifically (**Wajieh**:**1993**).

The researcher collects his data and information either from the whole indigenous community or from a sample representing this community (Ahmed: 1987), where the research sample was selected including (6) the professional volleyball Spikers of the Iraqi national team, who perform the star trek serve skill. The sample constituted a ratio (33.333) %) from the indigenous community. In order to be coherent, the sample was consistent in length, age, mass and training age. Where the value of this coefficient was less than (30%), which indicates the coherence of the sample (**Wadih: 1999**), (age 24.833 ± 2.858), (training age 9.667 ± 2.503 years), (length 190.168 ± 4.021 cm), (mass 86 ±7.694 kg) and (leg length 101.833 .8 2.563 cm). A number of research tools and instruments were used (Arab and foreign references, legal volleyball court,(5) legal balls, tape measure, Zebris power measuring bench,(1) Chinese Casio video camera with frequency (240 p/ sec), and Pentium-4 computer).

The researchers conducted an exploratory experiment on (3) spikers of the Iraqi volleyball Premier League; this experiment included identifying the force measuring device work by zeroing the bench according to the ground rigidity that shows its validity. This experiment has been conducted to find out the power imposed for the bench and how the forms, characteristics and values of curves are obvious, in addition to identifying the place and height of the camera. The research used the following mechanical variables:

1-Maximum landing force: it is the highest value recorded on the curve within the landing stage on the bench, measured by Newton.

2- The maximum landing force time: The taken time was counted for the nearest millisecond from the moment of contact with the bench until the maximum landing force was recorded. It was measured by Seconds.

3- Minimum landing force: it is the lowest value recorded on the curve within the digging stage on the bench measured by Newton.

4-**- The minimum landing force time:** The taken time was counted for the nearest millisecond from the moment of contact with the bench until the minimum digging force was recorded. It was measured by Seconds.

5- Maximum hitting force: it is the highest value recorded on the curve within the final hitting stage on the bench measured by Newton

6- **The maximum hitting force time**: The taken time was counted for the nearest millisecond from the moment of contact with the bench until the maximum hitting force was recorded. It was measured by Seconds.

7- Landing angel: It is the angle between the horizontal level and the line from the center of body weight and the anchor point of the landing foot in the first contact of the pushing leg with the bench; it was measured from the back by degrees

8-Maximum bending of the knee joint of the pushing leg: it is the angle between the line from the ankle joint to the knee and between the line from the knee to the hip joint of the pushing leg; it was measured from the back at the lowest value by degrees

9-The angle of the trunk at the maximum bend of the knee joint of the pushing leg: it is the angle between the horizontal line parallel to the ground from the hip joint and the line passing through the trunk; it was measured from the front at the lowest value of the knee joint by the degrees

10-Rising angle: It is the angle between the horizontal level and the line from the center of the body weight and the anchor point of the rising foot in the last contact of the pushing leg with the bench ; it was measured from the front by degrees

11- Jumping height: It is the length of the straight line between the vertical lines from the hip joint at the moment of leaving the bench to the intersection point with the horizontal line passing through the hip joint at the moment of hitting the ball is; it was measured by centimeters. The researcher conducted the main experiment on the research sample of (6) spikers on 11 and 13/1/2019, where the sample was photographed by a Chinese-made video camera (Casio) type with a frequency of (240 p/s) placed on a tripod through all technical performance stages of the skill, at a distance (5.50 m) from the place of the spiker performing the star trek serve skill and the height of the lens (2 m) from the ground. The Zebris power measuring bench was placed far away from the final line of the courtat 10 cm off the court. And then the experiment was conducted and several attempts for each spiker were photographed to choose the best attempt, where the spiker steps closer to the bench of strength measuring and jumps to perform the star trek serve skill. One of the analyzing programs was used with a developed calculator to get more accurate results. (**Kinovea**) which is a specialized program focusing on the computer was used to analyze sports movements to figure out the values of angles, dimensions and times after transferring files (video clips of the movement) and open them through the program which is an integrated file allowing users of this system to show the video collection in the form of animated thumbnails that can be saved and referenced, allowing them to encode certain movements within the video and detect movement in frame after frame or slow motion, and enable them to add any content to their videos by using drawing tools and adding different shapes such as lines and arrows with a description of the sites. The data were statistically processed using the statistical bag program (SPSS ver. 23) through the following rules (1- Arithmetical mean, 2-standard deviation, 3-percentage, 4-simple correlation).

4- Discussion of the Results

Table (1)

Shows the arithmetical mean and standard deviation values of the mechanical variables for the research sample

n±	h	Measuring unit	**mechanical variables**	N
3.189	60.833	degree	Landing angel	1
282.049	1748.667	Newton	Maximum force for landing	2
0.034	0.077	second	The maximum landing force time	3
44.933	612.167	Newton	Minimum force for landing	4
0.026	0.198	second	The minimum landing force time	5
51.332	995.833	Newton	Maximum hitting force	6
0.027	0.083	second	The maximum hitting force time	7
8.408	119.5	degree	Maximum bending of the knee joint of the pushing leg	8
7.737	105.667	degree	The angle of the trunk at the maximum bend of the knee joint of the pushing leg:	9
4.131	84.333	degree	Rising angle	10
7.448	92.667	cm	Jumping height	11

Table (2)

Shows the correlation coefficient values between the mechanical variables and the jumping height for the search sample

Jumping height		mechanical variables	N
Sig	correlation coefficient		
0.050	0.811	Landing angel	1
0.921	0.052	Maximum force for landing	2
0.502	0.346	The maximum landing force time	3
*0.026	0.866	Minimum force for landing	4
*0.019	0.884	The minimum landing force time	5
*0.025	0.869	Maximum hitting force	6
0.085	0.751	The maximum hitting force time	7
*0.044	0.824	Maximum bending of the knee joint of the pushing leg	8
*0.012	0.908	The angle of the trunk at the maximum bend of the knee joint of the pushing leg:	9
*0.014	0.0901	Rising angle	10

From the table above, there is no significant correlation between some biomechanical variables of the force-time function (maximum landing force, time taken for the maximum landing force, the maximum hitting force time, landing angle) with the jumping height variable. This is due to the difference in the spikers' levels, in addition to the choice of each spiker to the best position to bend and hit and the difference in the spikers' strength level, as well as, closer steps to lean on the bench, all contributed to not correlate with the jumping height.

Discussing the results of the correlation values of the variables of the minimum landing force and the maximum hitting force and the time taken for the minimum landing force with jumping height

Force plays a prominent role in achieving good results when playing sports, especially in terms of producing power at the right moment and speed, as the concentration of power with increased speed is one of the characteristics of good skill performance (Seddiq: 1980). The power focusing on the bench

is an indicator for the spiker's rush (approximate speed); and this time may be long or short according to the horizontal speed obstruction, as the spiker attempts at the maximum bending to convert the horizontal speed to semi-vertical. Basing on this, the great approximate speed requires a great force in order to obstruct the horizontal speed and turn it into semi-vertical; therefore, the relationship between the two forces will be significant (the minimum landing force and the maximum hitting force), as the minimum landing force will match the maximum hitting force when contacting, which in turn movesto the maximum final hitting force. The minimum landing force is the most critical moments of the stage affecting the technical performance level and the required preparing for hitting as a result of the increased load on the pushing leg, which requires increasing in the force exerted at the end of the blockingstage of its standardized relationship affecting the total hitting force, so we discovered that it is the most important impact on the technical performance level; thatwas confirmed by some references as one of the most important requirements of the stage (**Karl: 1985**). In addition, this relationship resulted from the low values in the blocking stage and because of the short time at this stage, which means if a significant change in the momentum of the body, the spiker must use a great hitting within using a small space of contact with the ground and by the law Newton III, the ground returns this hitting to the body, which in turn moves as it has less mass than the earth. When the force is great and the time is short, the spiker gets a big hit. At this stage, there is a change in the body's momentum direction from the horizontal to the semi-vertical direction and at every moment of performance (rising) the body possesses kinetic energy and potential energy, which collectively constitutes total mechanical energy. The taken time for the blocking force impact occurs between the initial and final hitting time which is very important in the hitting process as it’s a combination of the sum of multiplying force by time. The sudden change of the body state influenced by force is directly related to the element of time (**Talha 1993**). Therefore, the time of the hitting stage will correspond to the final hitting time, which in turn affects the total hitting time, so the spiker must be careful to synchronize the use of force and harness it through the appropriate bending and stretching and transfer it through the body joints within the flow of movement temporally and spatially. If there's no corresponding such as early or late bending, it leads to losing the force. In addition, at this stage of (the minimum force stage) the body weight line is heading downwards. When the body begins to descend gradually through bending the knee joint of the pushing leg, the force that works downwards is the body weight plus the force used towards the ground; thus the body moves downwards, but the earth reaction is less than the weight of the body. Hence, we conclude that when the body direction is downwards, the earth reaction force is less than the body weight force; therefore the force will be low, and the body must be in a vertical position and on the force effect line because the vertical position qualifies it to achieve better force (**Wadih: 1993**). Maximum hitting force variable is one of the most important variables in carrying out this skill, as a volleyball spiker is characterized by exerting all his myodynamic to achieve the vertical distance required to hit the ball in the shortest possible time, because the speed of jumping depends on the total exerted forces in the required direction with appropriate flying angle to achieve the skill goal. It's mentioned that developing the exerted force during the movement and in a right scientific technique is the basic rule for a better level of performance (**Soliman and Awatef: 1978).**

Discussing the results of the correlations between the maximum bending of the knee joint of the pushing leg, the trunk angle during the maximum bending of the knee joint of the pushing leg and the jumping height

The right timing and kinetic sequence during technical performing and the bending and stretching movements of the body joints directly related to the movement of the rest of the body including the trunk which is approximately 43% of the body mass, it means that the right timing between the bending and stretching movements is closely related to the movement of the rest of the body parts which results in goodkinetic transferring and therefore an appropriate reaction (**Saeb: 1991**). In this skill, there is a bend in the knee and the trunk angels because the kinetic speed and acceleration that precede the instantaneous stopping of the pushing leg for changing the momentum direction will enable the spiker to adapt two perfect angles in order to block force and reduce inertia, in addition to preventing injuries resulting from the legs' muscle fibers tension which sometimes reach its maximum degree. Bending of the knee joints and trunk before the moment of leaving in accordance with the performance requirements and kinetic duty, which provides a great elementary force, increases acceleration, as well as, the trunk position that begins to tilt resulting in generating torque that causes the trunk to gain angular speed and thus angular momentum during the tilt process and then bend forward, helpinggenerate extra force. There are two basic principles that can be applied, especially in running, jumping and throwing when the spiker is interested in getting maximum speed and force. They're defined as using all joints that can be used, as well as, using each joint in its order and timing (**Peter: 1996**), where the rising angles can be in the desired direction if the true path of force was used by all joints involved in muscular action and its proper timing to determine the correct path to the spiker's weight center.

Discussing the results of correlation between the rising angel variable and the jumping height:

The researchers attribute the reason for the significant correlations to the performance nature of this skill because it needs sufficient vertical and horizontal pushing to jump and reach the appropriate height in order to hit the ball in the right place and time, in addition to the speed of the center of the body's weight, which requires both pushing and time elements. When pushing increases with less time, the speed will increase in this skill, which requires the highest vertical flight distance through the highest point of the hip joint at the moment of hitting the ball and the highest speed of the body weight center which expresses decreasing in the exerted effort. Therefore, the transitional speed of the body requires a lot of searching and finding out the possibility of shifting the speed from the horizontal to the semi-vertical direction during the rising process, which is one of the key factors in success when applying effective rising in order to achieve the mechanical goal of the movement. the rising angle in this skill plays an active role in determining the correct path to the body's weight center beyond the rising i.e.(flying stage); this requires perfect investment towards the path to be achieved through the effective stretching of the knee joint of the pushing leg before the moment of leaving. Wolf pointed out

that if the effective force doesn't impact during the rising of a work line that passes through the body weight center away from the torque setting, it will cause the body to tilt in the opposite direction (**Wolf Can: 2001**). Accordingly, the rising angle has contributed in determining the final work of the star trek serve skill during jumping after leaving the ground in accordance with the mechanical requirements of this skill. Therefore, this angle is one of the variables related to the angle stretching of the knee joint of the pushing leg before the moment of leaving and the accompanied force of the ground reaction, which matches determining the special kinetic form of the body and having the right position of the body weight center path, which is represented in warming up the appropriate and right position of the trunk during performing the star trek serve skill while jumping in order to achieve kinetic apraxia for both the trunk and arms. There's no doubt that the rising angel is one of the main and significant elements that works on determining the height level which the spiker's weight center can reach. In this regard, **Samir** has confirmed that the angel measurement is subjected to the performing nature of the skill to be carried out ***(Samir: 1999***). The objective of modern mechanical analysis studies is how to get the greatest mechanical energy and the possibility of retaining a significant amount of it during the rising stage. We can get energy from increasing approximate running and the movement speeds of the limbs so that we can't loss a significant amount of mechanical energy, which helps the spiker to rise from the right angle and at the right time to perform the star trek serve skill perfectly. Accordingly, the rising angle determines the right position of the body at the moment of pushing, and the body's weight center path cannot be changed in the required direction after the rising process (after leaving the bench), as well as, it draws the final path of the movement of the body's weight center according to the mechanical requirements of the jumping skill. The rising angle works on retaining the amount of movement in such a way that the spiker might not lose speed during flying; the loss of movement decreases in case of appropriate angles (Yaroub: 2001).

Conclusions

1- There is a similarity in the form nature of the power-time function characteristics for the star trek serve skill of volleyball because it contains two peaks; the first was the primary force (maximum landing force) and the second was the final force (maximum pushing force).

2- The landing force on the bench is much greater than the maximum final pushing force in all performance of the star trek serve skill of volleyball.

3- There is a difference in the characteristics of the recorded curves between the performance and their impact time along the stages of the star trek serve skill of volleyball recorded on the bench.

4- The characteristics of the mechanical variables curves achieved in the step are conditioned by two matters; the first is legal by not committing a mistake and the second is mechanical to convert these variables from their horizontal to vertical shape during performing the star trek serve skill of volleyball.

5- Some mechanical variables of the power-time function which are (maximum landing force, maximum landing time, maximum pushing time, landing angle) have no impact on the jumping height for the star trek serve skill of volleyball.

6- Some mechanical variables of the power-time function which are (minimum landing force, minimum landing force time, maximum pushing force, maximum bending of the knee joint of the pushing leg, angle of the trunk at the maximum bending of the knee joint of the pushing leg, rising angle) impact on achieving the best jumping height in the star trek serve skill of volleyball.

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