22 - KINEMATICS ANALYSIS OF SUSPENSION THROWING IN HANDBALL

KARINE AMANCIO VERLINCK
ANDREI FELIPE STADTLOBER
TIAGO LEITE
LISSANDRO MOISÉS DORST
DÉBORA GOULART BOURSCHEID DORST
FACULDADE ASSIS GURGACZ – CASCAVEL – PARANÁ- BRASIL
karine_verlinck@hotmail.com

INTRODUCTION

This research tells about the kinematic analysis of the jumping and throwing movement in handball, with adult female athletes of the Cascavel team in the State of Paraná.

Handball is a complex and collective sport, covering various athletic types, in other words: the runner, jumper and thrower, encompassing thus three fundamental physical qualities for handball: speed, skill and strength, automatically forcing the athlete to spend a lot of strength (MECHIA, 1981)

Practicing a sport such as handball, the athlete must have a minimum of technical skills inherent to the game. However, we also know that it is not wise to put these bases through a monotonous learning, to catch and throw the ball. (KÄSLER 1980)

This activity is practiced with a small ball, and so can be handled perfectly with one hand. The sports court is a rectangle measuring 20 x 40 meters (21.87 x 43.75 yards). This court has a center line that divides it into two equal halves. Each part has an area of goalkeeper, almost a semicircle formed by 6 meters (6.56 yards)of radius; has another larger area, called the line of 9 meters (9.84 yards). Between these two areas and the bottom line is the mark of 7 meters (7.65 yards), where is done the penalty shot. (ZAMBERLAN 1999)

According to each situation, the throws can be performed in very different ways, always depending on the action of the opponents, always alternating as height, direction and strength. Thus, there may be various types of pitches and ways, the athletes should be able to pick and know how to choose the best pith that fits to the circumstances in which they are (ZAMBELAN, 1999).

Among the pitches, the suspension style is frequently used, especially for players who play in the creation of the game, where the player holding the ball progresses directly to the goal and taking advantage of the three steps, takes the ball to the hand, jumping and moving forward, dropping the ball as close as possible to the goal. The pitch should be executed when the player reaches the highest point of the trajectory of the jump, because in this moment the pitch can achieve maximum power. The fall should perform about the same impulse foot. The shoulder should help the pitch to achieve greater strength (MECHIA, 1981).

According to Zanberlan (1999), the suspension throw is used to win and overcome the opponents above them. Should be performed with the player in the air (suspension) being preceded by three steps before the final shot. The jump should be vertical and the release of the ball (pitch) should be done at full power.

This pitch can be used in two different ways, depending on the presence or absence of defense. The shot is typically done with defense in attack conditions, and the pitch without defense is primarily used in situations of counter attack. (MEDEIROS aput DORST et al. 1998).

The different bases of handball can be detailed analyzed by sports biomechanics, an area of great scientific importance to the sport, which helps to improve the performance of athletes and their teams. Due to the speed of the motor actions and characteristics of the game, the various qualities muscle and motor speed, can only be precisely recorded through biomechanical analyzes (GRECO, 2000).

Biomechanics is a discipline, among the sciences derived from the natural sciences, which comes to physical analysis of biological systems, hence, the physical analysis of body movement. These movements are studied by mechanical laws and standards according to the specific features of the human biological system (AMADIO, 1996). Hall (1999) describes the biomechanics as a science devoted to the study of biological systems from a mechanical perspective.

By other hand Chapín et. al., (2001), says that biomechanics is a multidisciplinary science that requires a combination of knowledge of the physical sciences and engineering with the biological and behavioral sciences.

To Amandio (1996), he says that the current development of biomechanics is expressed by the new procedures and techniques of research, in which we recognize the growing bias of combining different disciplines in motion analysis. Currently, the progress of techniques for measuring, storing and processing data contributed greatly to the analysis of human movement.

Hall (1999) mention that the knowledge of basic biomechanical concepts is also essential for the physical education teacher competent therapist, doctor, coach, personal trainer or instructor to exercise. That knowledge of this area makes possible a fundamental understanding of the mechanical principles as may be applied to the analysis of movements of the human body.

Still the same author says that to analyze human motion one of the studies to be done is kinesiology which is usually incorporated into biomechanical studies. Most kinesiological analysis is considered qualitative because it involves the observation of a movement, break it into pieces of the skills and the contributions identification to the movement. Now the biomechanics is used as a precursor for the introduction of more quantitative studies.

According to Fornasari (2001), kinesiology is the study of the human movement. It is a discipline that requires a schedule of study and a constant work. It is fundamental to the other studies, such as biomechanics.

The biomechanical approach for the analysis of movements can be qualitatively, with the observed and described motion and or quantitative means being made some measure of motion. Can be conducted since two perspectives: the first, kinematics, relates to the characteristics of the movement from a spatial and temporal perspective, and kinetics which is the area of study that examines the strength that act in a system, as a human body or any other object (Hamill, 1999)

According to Hall (1999) the word quantitative requires the participation numbers, and the qualitative refers to description of quality without using numbers. A biomechanical analysis involves the depiction of movement to determine, for example, how fast an object is moving, what distance and height that it reaches. Thus, position, speed and acceleration are important components in a kinematic analysis.

Therefore, the goal of this study was to analyze the movements of kinematically suspension throw in handball of adult athletes, identifying their technic of movement execution in handball suspension throw through spatial variable and space-time, checking the performance of athletes to make the correct pitch and comparing the performance technique of shooting in

suspension of athletes who have succeeded against those who have failed and relating them to studies published in the scientific literature.

MATERIALS AND METHODS

This work had as feature the transversal description, where the technique of suspension throwing was examined in handball in an indoor sport court, located in Cascavel, a county of the Paraná State. First of all, it was in contacted the team coach, requesting the possibility of conducting the research. After the agreement of the coach, it was scheduled a date for the collection of data, during a training sequence of the athletes.

To authorize the realization of this research, this work was submitted and approved by the local ethics and human research of Assisi School Gurgacz under protocol 296/2007, according to Resolution 196/96 of the Ministry of Health.

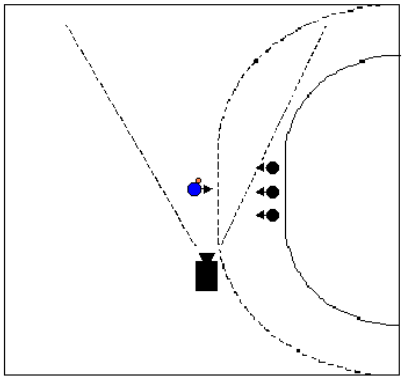
The equipment used to collect data were: a cinematic system of videography with dimensional image acquisition frequency of 60 Hz to obtain the images that was used a mini DV camera, the data analysis was performed using the system Simi Twinner Pro. To perform system calibration it was used a ruler with a meter dimension.

The data collection was made during a training session, previously scheduled with the coach and athletes, a sports gymnasium of the city previously mentioned. Before beginning the collection was handed to the athletes a term of informed consent that had: a form of data analysis, the risks, the benefits, the research objectives and also contained the agreement signed by the athletes. And this term was given to the researcher.

For the execution of the movement and image acquisition, the camera was positioned in the sagittal plane of the suspension throw. The device captured the movements of pitching in suspension and also the initial trajectory of the ball towards the goal, the athletes performed the pitch before the goal area line. The calibrator was positioned close to the centralized location of the pitch.

The athletes were instructed to perform their usual warming work. Each athlete performed five pitches in sequence, they were also oriented, that perform the shooting as they were in a game, in other words, demanding maximum concentration. To simulate a game situation for the athlete, other players were placed representing the defense.

Figure 1 - Positioning of the camera in relation to the pitch.



The study population was comprised of athletes of handball. The sample consisted of evaluating 7 female athletes who practice the sport of handball in the adult team, which had no lesions in the upper and lower limbs and who accepted to participate in the collection and consequently signed the free agreement form. The male athletes were excluded from the study and those who did not practice the sport in this team.

To give more comfort of the athletes during the data collection, the court was zoned out, so anyone who was not participating in the research could cause interference.

The athlete was free to give up the study at any time or if an injury occurred. If this had occurred, the athlete would have been sent to a health care center.

All information collected during the study was confidential, all values were found in the average values of all athletes who took part in this study. The names of the athletes whose were analyzed were not disclosed and data were given to the team coach.

The variables analyzed were:

Throwing Phase Time (TPT) that corresponds to the time that the athlete remained in the air since the last instant of contact with the ground until the moment of release the ball.

Maximum Angle of Knee Flexion (MAKF), which is the largest knee angle made by the athlete before the loss of contact with the ground.

The Variable Height of the Ball Output (HBO), which corresponds to the height that the ball was in the ground, the moment in which the athlete loses contact with the ball.

Ball Speed Output (BSO), correspond the speed that the ball was in the time that the athlete releases it.

And the variable of the Behavior Average of the Angulation of the Elbow and Shoulder during the time of the aerial phase of the pitch, which are the angles of the shoulder and elbow during the flight of the athlete with the ball.

For the data analysis was used descriptive statistics, through measures of central tendency (average) and measures of variability (standard deviation) to describe the jump throw. The variable of the Behavior Average of the Angulation of the Elbow and Shoulder during the time of the aerial phase were interpolated in the OrigimLab system, in order to be built graphic curves 1 and 2.

RESULTS

During the act of data collection were performed 28 pitches in suspension, with a win percentage of 75 % (21 pitches), and above these were selected a throw of each athlete at random.

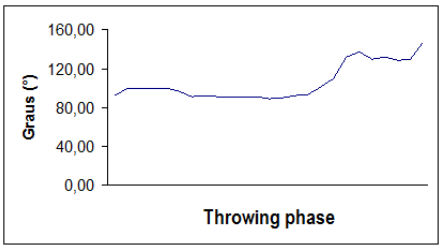
In the table 1 are presented data variables, TPT, MAKF, HBO, OSB, with mean and standard deviation.

Table 1 - Data of Average and Standard Deviation of the Variables Time Phase of the Throwing (TFT) Maximum Angle of Knee Flexion (MAKF), Height of the Ball Output (HBO) and Ball Speed Output (BSO).

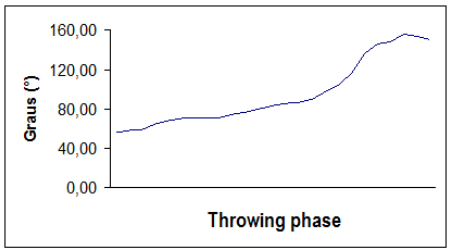
Variables	TPT (s)		HBO (cm)	SBO (m/s)
Sujeito 1	0,367	163,78	228,13	21,27
Sujeito 2	0,234	155,38	228,13	18,89
Sujeito 3	0,234	158,55	212,62	23,81
Sujeito 4	0,384	150,18	235,88	20,53
Sujeito 5	0,317	146,8	225,51	20,51
Sujeito 6	0,317	156,19	228,13	17,49
Sujeito 7	0,384	152,91	246,13	29,96
Média	0,32	154,83	229,22	21,78
Desvio Padrão	0,06	5,57	10,19	4,11

In the graphics 1 and 2 are shown the variables of the average behavior of the elbow and shoulder during the time of the throwing phase.

Graphic 1 – Average behavior of the elbow angulation during the time of the throwing phase.



Graphic 2 – Average behavior of the shoulder angulation during the time of the throwing phase.



DISCUSSION OF RESULTS

Analyzing the results in variables TPT was found a value of 0.32 0.06s and compared with the study of Zanon et al. (1998) which analyzed the Brazilian women's team handball, and resulted in variable a time of 0.34 0.09s, there was a great similarity in the results between the two teams, which demonstrates a good technical level in this variable to the team analyzed. Zamberlam (1990) says that "It is necessary to control and keep the body enough time in the air, before the pitch of the ball, looking for the balance and the best time to throw the ball."

Now analyzing the results of the variable MAKF it was verified in this study a value of 154.83 5.57° compared with the analysis of Zanon et al. (1998), which had as result of the variable an average angulation of 141.58 9.09º, it was also identified little knee flexion in the two teams in the relationship described by Zamberlam (1990) that says "the impulsion leg should be bent at an angle of 90°" and the average angle flexion of the two teams was only 25.17° and 38.42 respectively, what could be occurred by the fact of flexing 90º the athlete would lose time and speed and could not shoot well the pitch.

In variable HBO, it was noted that the results presented by the team were 229.22 10.19cm showed little variation between the subjects, because the athletes were instructed to perform the pitch as if they were in a game situation, in other words, demanding maximum effort, this difference in the execution of the throw is characteristic suspension throwing in attack situation, since the height of the jump according to Zamberlam (1990), depends on the speed and impulse that the athlete performs before the jump.

As for variable SBO that resulted in a value of 21.78 4.11 m/s and compared with Zanon et al. (1998) that was the result of 19.34 1.32 m/s, it was noted a better performance of the team analyzed. The best performance can be due to the fact that the study of Zanon et al. (1998) do not specify if the pitches of the athletes of the Brazilian team were running at full power, or by the fact that the athletes in this study underwent a displacement greater posterior forearm before throwing that for Zamberlam (1990) generates a higher power .

In the graphic 1 is showed that the average angle of the elbow during the flight of athletes remains with little variation in the initial instants of pitch. After a few moments in the air, the athletes start an extension of the forearm increasing the angle of the elbow to increase the power of pitch, aiming the successful shot.

In the graphic 2, that represents the average behavior of the shoulder during the flight time with the ball, it was also realized that the athletes increased slightly the angle during the preparation of the pitch, around 40º only, thus when reaching the final moments of the flight and with increasing angle of elbow and extension of the forearm also occurs an increase in the angle of the shoulder going close to 160°.

CONCLUSION

It can be concluded in this study that the technique of the athletes in movement of suspension throwing execution in handball is being performed very well, because, through the analysis of the results in relation to the comparison with the study of Zanon et al. (1998) it was verified a great similarity.

It is also noted that due these good performances to the movement pitch in suspension in the athletes had as result in a high level of their exploitation.

After analysis, it is expected that these findings contribute to help other researchers who are interested by this area, and also can use this data for future studies, analyzing also other variables as, for example, the rotation of the trunk of the athlete, but for this it would be necessary a better analysis system, as for example, a three-dimensional system for an improved analysis of the images.

REFERENCES

CARR, G. Biomecânica do Esporte, Editora Manole 1ªed. São Paulo, 1998

CHAFFIN, D. B., ANDERSON, G. B. J., MARTIN, B. J. Biomecânica Ocupacional, Editora Ergo, Belo Horizonte, 2001.

FORNASARI, C. A. Manual para Estudo da Cinesiologia Editora Manole, 1ª ed. São Paulo, 2001.

GRECO, P. J. Caderno de Rendimento do Atleta de Handebol, Editora Health, 1ª ed. Belo Horizonte, 2000.

HALL, S. J. Biomecânica Básica, Editora Guanabara Koogan, 3ª ed. Rio de Janeiro, 2000.

HAMILL, J. e KNUZEN, K. M. Bases Biomecânicas do Movimento Humano, Editora Manole, 1ª ed. São Paulo, 1999.

KASLER, H. Handebol, Editora Ao Livro Técnico, 1ª ed. Rio de Janeiro, 1980.

ZAMBELAN, E. Handebol Escolar e Iniciação, Editora Imagem, Cambe, 1990.

ZANON, S., DORST, L. M., CATTELAN, A. V., FERREIRA, G. M. L., TEIXEIRA, J. S., ESTRRÁZULAS, J. A., MOTA, C. B. Análise Cinemática de Variáveis Selecionadas do Arremesso em Suspensão do Handebol, 1998.

ADDRESS: R: GUARAPARI, N° 65, CENTRO, NOVA AURORA
E-MAIL: karine_verlinck@hotmail.com

KINEMATICS ANALYSIS OF SUSPENSION THROWING IN HANDBALL

ABSTRACT

The focus of this study is the suspension pitch in handball. To make an analysis of this pitch, a kinematic movement study was made, in which were examined variables as; the phase time of the pitch, max angle flexion of the knee, height and exit velocity of the ball, and the average behavior of the shoulder elbow during the time of the aerial phase of the pitch. A two-dimensional kinematic videography system was used to produce the analysis, and for the digitalized analysis of the data was used the simi twinner pro system Pro. The purpose was to analyze the kinematics of the suspension throwing of the team, through space-time variables in the performance of the female athletes about the success of the shot. The data collection was performed on a normal day of training, where athletes performed a warm up for the images of the pitches that were to be done in the continuation. After this, the data were analyzed and significant results were discovered, turns out the team demonstrated a good technical level when compared with the study of the Brazilian national team of handball the data were close or higher as in the time variable phase of suspension shot that the team reached 0.32 ± 0.06s and compare with other author which resulted in 0.34 ± 0.09s or the ball output speed variable that the analyzed team had was of 21.78 ± 4,11m/s and the national team reached 19.34 ± 1.32 m/s. The result is that the team presented a good technical level in the variables, the advantage of the pitches used was of 75%.

KEYWORDS: Kinematic of the movement. Handball. Suspension Throwing.

ANALYSE CINEMATIQUE DU TIR EN SUSPENSION EN HANDBALL

RÉSUMÉ

L'objectif de cette étude est le tir en suspension. Pour faire une analyse de ce tir, une étude a été réalisée sur le mouvement cinématique, qui a examiné des variables telles que le temps de la phase du tir, l'angle de flexion maximale du genou, la hauteur et la vitesse de sortie de la balle, et le comportement moyen du coude de l'épaule pendant la durée de la phase aérienne du tir. Pour l'analyse, nous avons utilisé une système cinématique de vidéographie à deux dimensions et pour l'analyse numérique des données, nous avons utilisé le système Simi Twinner Pro. L'objectif était d'analyser la cinématique du tir en suspension de l'équipe à travers des variables d'espace-temps, la performance des athlètes lorsque le succès du tir. La collecte des données a été effectuée sur une journée de formation, où les athlètes ont fait un échauffement pour les images du tir. Après les données être analysées, des résultats significatifs ont été trouvés, comme l'équipe a démontré un bon niveau technique, en caparaison à l'étude des données de la selection brésilienne les données étaient proches ou supérieurs avec une variable de temps de phase aérienne du tir, l'équipe a atteint 0,32 ± 0,06s et en comparant avec autre auteur qui a eu le résultat de 0,34 ± 0,09s ou dans la variable de vitesse de sortie de la balle que l'équipe analysée a eu une valeur de 21,78 ± 4,11m/s et la sélection a atteint 19,34 ± 1,32 m/s. Nous pouvons conclure que l'équipe a présenté un bon niveau technique ans le variables, l'utilisation des tirs utilisés, quia été de 75%.

MOTS-CLÉS: Cinematique du Mouvement. Handball. Tir en Suspension.

UN ANÁLISIS CINEMÁTICA DEL LANZAMIENTO EN SUSPENSIÓN EN EL BALONMANO

RESUMEN

El foco de este estudio es el lanzamiento en suspensión. Para hacerse un análisis de este lanzamiento, fue hecho un estudio cinemático del movimiento, en que fueron analizadas variables como: tiempo de la fase del lanzamiento, ángulo de flexión máxima de la rodilla, altura y velocidad de salida de la pelota, y comportamiento medio del codo y del do hombro durante el tiempo de la fase aérea del lanzamiento. Para análisis fue utilizado un sistema cinemático de video grafía bidimensional y para análisis digitalizado de los datos se utilizó el sistema simitwinner pro. El objetivo fue analizar la cinemática del lanzamiento en suspensión del equipo, a través de variables espacio-temporales, el desempeño de las atletas cuanto al éxito del lanzamiento. La colecta fue hecha en un día de entrenamiento, en que las atletas hicieron un calentamiento para las imágenes del lanzamiento enseguida. Después de eso, los datos fueron analizados y se encontraron resultados significativos, ya que el equipo demostró un buen nivel técnico, pues, comparando con el estudio de la selección brasileña, los datos quedaron próximos o mayores como en la variable de tiempo de fase aérea del lanzamiento, que el equipo logró 0,32 ± 0,06s y al comparar con otro

autor que tuvo como resultado 0,34 ± 0,09s o en la variable de velocidad de salida de la pelota que el equipo analizado tuvo un valor de 21,78 ± 4,11m/s y la selección consiguió 19,34 ± 1,32m/s. Se concluye que el equipo presentó un buen nivel técnico en las variables, el aprovechamiento de los lanzamientos utilizados, que fue de 75%.

PALABRAS CLAVE: Cinemática del movimiento. Balonmano. Lanzamiento en suspensión.

UMA ANÁLISE CINEMÁTICA DO ARREMESSO EM SUSPENSÃO NO HANDEBOL

RESUMO

O foco deste estudo é o arremesso em suspensão. Para se fazer uma análise deste arremesso, foi feito um estudo cinemático do movimento, em que foram analisados variáveis como: tempo da fase do arremesso, ângulo de flexão máxima de joelho, altura e velocidade de saída da bola, e comportamento médio do cotovelo do ombro durante o tempo da fase aérea do arremesso. Para análise foi utilizado um sistema cinemático de videografia bidimensional e para análise digitalizada dos dados utilizou-se o sistema simi twinner pro. O objetivo foi analisar a cinematicamente do arremesso em suspensão da equipe, através de variáveis espaços-temporais, o desempenho das atletas quanto ao êxito do arremesso. A coleta foi realizada em um dia de treinamento, em que as atletas fizeram um aquecimento para as imagens do arremesso em seguida. Após isso, os dados foram analisados e foram encontrados resultados significativos, já que a equipe demonstrou um bom nível técnico, pois, comparando com o estudo da seleção brasileira os dados ficaram próximos ou maiores como na variável de tempo de fase aérea do arremesso, que a equipe atingiu 0,32 ± 0,06s e ao comparar com outro autor que teve como resultado 0,34 ± 0,09s ou na variável de velocidade de saída da bola que a equipe analisada teve um valor de 21,78 ± 4,11m/s e a seleção atingiu 19,34 ± 1,32m/s. Conclui que a equipe apresentou um bom nível técnico nas variáveis, o aproveitamento dos arremessos utilizados, que foi de 75%.

PALAVRAS CHAVE: Cinemática do movimento. Handebol. Arremesso em Suspensão