137 - BASKETBALL JUMP SHOOT COORDINATION IN CHILDREN

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INTRODUCTION

The jump shoot has been considered the most effective (COLEMAN e RAY, 1976) and efficient way to score points in basketball (OKAZAKI et al., 2004-a). However, learning of such complex movement is one of the most difficult between several basketballs techniques (OKAZAKI & RODACKI, 2005). Thus, jump shoot technique may be influenced by several factors such as: distance from the basket (RODACKI et al., 2005; MILLER & BARTLETT, 1996; ELLIOTT, 1992), body position at the release instant (KNUDSON, 1993), displacement (COLEMAN e RAY, 1976; DAIUTO, 1971), etc. Several studies have analyzed this ability using qualitative analysis, mathematic models and some experimental evidences (KNUDSON, 1993). On the other hand, only a few studies have quantitatively assessed movement coordination, i.e., the way joints move with respect to each other in a coordinated manner (BUTTON et al., 2003).

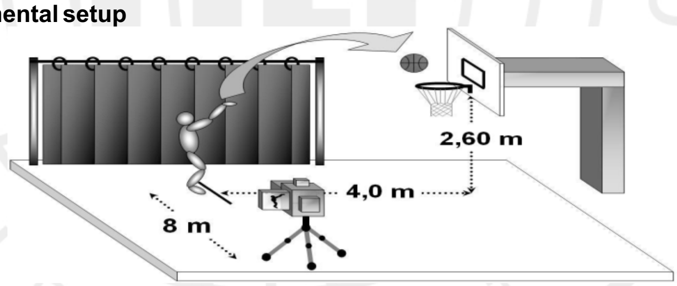
The aim of this study was to analyze and describe jump shoot coordination among children. It may help to identify relevant points to be emphasized in the teach-learning process, providing information for a better training and performance.

METODOLOGIA

Eight children (10,0 ± 0,5 years; 39,88 ± 4,48 kg; 1,45 ± 0,09 m) with previous experience in basketball (2,25 ± 0,79 years of basketball practice), that train basketball at least two sessions per week, were selected. The participants reported no injury or incapacity that could influence their performance. Before the beginning of the study, all subjects were informed about the procedures and their tutors signed an informed consent form. Before the experimental procedures, a warn up of 15 minutes was conducted. Warn up consisted of generalized exercises and was controlled by their coach. After the warm up, subjects practiced some jump shoots. The basket distance (4,0 m) and height (2,60 m),were adapted to match the specifications used by the rules of mini-basketball. A further argument for the use of adapted dimensions was because subjects were familiar with such conditions in their training sessions. The basketball shoot coordination was analyzed by quantifying shoulder, elbow and wrist joint movements. A video camera (JVC, GRDVL 9500) was positioned perpendicular to the movement plane and with the focal centre directed to the shoulder and recorded all sagittal movements, sampling at 100Hz. The right side was used because all subjects were right-handed. Figure 1 shows a schematic representation of the experimental setup.

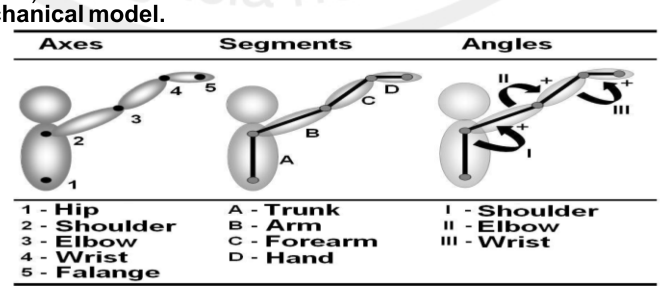
To access the movement performance, a set of five marks (30 mm of diameter) was fixed on the skin, to match with the following landmarks: (1) hip Iliac crest; (2) shoulder shoulder joint centre (2-5 cm below the acromium); (3) elbow humeral lateral epicondile; (4) wrist stiloid process of the ulnae; and (5) joint axis of the fifth falange fifth falange. This set landmarks was used to define the following segments: trunk (1-2), arm (2-3), forearm (3-4) and hand (4-5). The linkage formed by two adjacent segments was used to calculate joint angles (Figure 2). Because the shoot is predominantly performed in an unique plane (BUTTON et al, 2003; KNUDSON, 1993), a 2D analyses was considered adequate (BUTTON et al., 2003; OKAZAKI et al. 2005-a). For analysis purposes, only the propulsion arm (right arm) was analyzed (MILLER e BARTLETT, 1996; ELLIOTT, 1992).

Figure 1 Experimental setup



The images were stored in a video tape and transferred on to a personal computer. Then, all landmarks were digitalized through specific motion analyses software (Dgeeme version 0.98b) and a set of coordinates were obtained. These coordinates were filtered using a Butterworth filter second order recursive with a cut- off frequency of 10 Hz (OKAZAKI e RODACKI, 2005; ELLIOTT, 1992).

Figura 02 Biomechanical model.



The beginning of the movement was set as the first detectable instant subject started to lift the ball. The end of the movement was defined as the instant of ball release. Three movements were randomly selected from a set of ten successful shoots, from which the ensemble average of three was calculated to represent the pattern of the shoot. Joint angular displacement and velocity (shoulder, elbow and wrist) were used to analyse the jump shoot coordination.

The data were analyzed through descriptive statistic (mean and standard deviation). The Kolgomorov-Smirnov test was applied and confirmed data normality. The significance level set at $p<0,05$. To reduce the intra and inter-subjects variability, the data were normalized in function of the shoot movement time (RODACKI et al., 2005; OKAZAKI e RODACKI, 2005). This procedure is performed through a function spline, calculated through the Biomechanics Toolbox software (Manchester Metropolitan University, UK). Kinematics reproducibility (in an experimental condition) showed errors of 2,2º around the elbow and shoulder and 1,5 around the wrist joint.

RESULTS & DISCUSSION

The jump shoot duration lasted ~0,74s. The shoot preparation was performed with a longer duration (59% of total time), while the release period was performed using a shorter time (41% of total time). These results are slightly smaller than those reported in adults during the performance of free throws (0,86s - Rodacki et al., 2005). This difference indicated that children used a shoot with greater angular velocities in comparison to adults. This may be explained by the children's smaller capacity to generate force during the release of the ball. Such strategies also were identified by Hudson (1985) and Okazaki et al. (2005a), that inferred that players with smaller capacity to generate muscle strength used great angular velocity during the ball's release phase.

Shoulder, elbow and wrist angular joint displacement and velocities were analysed (Figure 3). The shoulder performed a gradual flexion during the large part of the initial phase of the shoot movement (1%-64%), which was increased during the final instants of the movement (65%-100%). The elbow was flexed during the shoot preparation phase (1%-59%) and extended during the ball's release phase (59%-100%). The wrist was extended during greater part of the movement to position the ball (1%-73%) and is flexed in the final instants of the release (74%-100%).

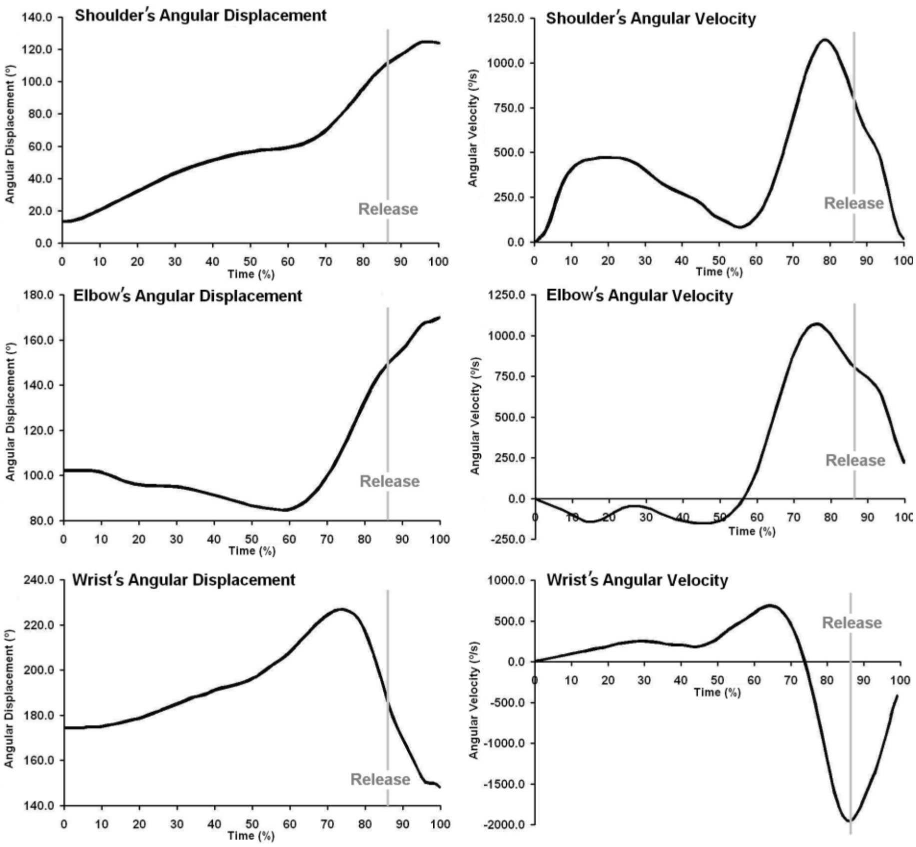
The shoulder and elbow joints showed angular velocities of 1000º/s, while the wrist showed even greater angular velocities (1500º/s) during the release phase. Despite the high values of angular velocity found, some children were not able to synchronize their joint peak velocities with the ball release instant. These findings corroborate with the arguments of Okazaki et al (2005-a) that children struggle to synchronise these two variables. These findings are also similar to others that analysed shoot distance (RODACKI et al., 2005) and inter-individual variability (OKAZAKI et al., 2004-b) and argued that players may control (anticipate or delay) joint peak velocities at release as a strategy performed to increase accuracy. It is speculated that changes observed in the present study are more related to the participant's inability to produce force than movement accuracy, as they were able to achieved greater joint angular velocities than adults.

The jump shoot has been described through five phases: preparation, ball elevation, stability, release and follow through (OKAZAKI et al., 2005-b). The preparation phase constitutes the initial phase of the movement and aimed to prepare the movement. In this initial phase angles of 13º, 102º and 174º were found around the shoulder, elbow and wrist joints, respectively. These values were similar to other studies in which jump shoots were performed by adult subjects (OKAZAKI et al., 2005-b; 12º, 136º and 193º, respectively).

The lift up phase begins with a flexion around the shoulder and elbow joints to place the ball on to a higher position (OKAZAKI et al., 2005-b). It is recommended to keep the ball close to the body to reduce the horizontal displacements and increase the stability during the shoot (KNUDSON, 1993). A shoulder, elbow and wrist alignment is also required to improve accuracy (KNUDSON, 1993) as misalignments may cause important deviation of the ball. In this phase the elbow joint must be positioned bellow the ball and in the direction of the target (KNUDSON, 1993; COLEMAN e RAY, 1979). The shoulder joint is flexed while the wrist is reciprocally extended.

The stability phase is characterized by a small variation in the elbow angular displacement (OKAZAKI et al., 2005-b). Some players may demonstrate small or absent stability phase in order to take advantage of the muscle stretch-shortening cycle (BUTTON et al., 2003). In the present study children showed reduced stability phase, however, they were not able to optimize release through a counter-movement (flexion-extension) to take advantage of the muscle stretch-shortening cycle. A counter-movement strategy around the elbow joint has been reported in other studies (Okazaki et al., 2005-a) as a strategy to improve release velocity. Wrist joint, howerver, showed a counter-movement (extensio-flexion), as reported in other studies with adults (RODACKI et al., 2005; OKAZAKI et al., 2005-a).

FIGURE 3 Shoulder, Elbow and Wrist Angular Displacement and Velocity.



The release phase is started by elbow extension and/or wrist flexion with its end determined by the instant the ball lost contact with the hand (OKAZAKI et al., 2005-b). The present study showed an “in phase” movement between the shoulder, elbow and wrist joints. This strategy may be interpreted as a form to simplify the control variables of the movement and minimize the central nervous system's demand (OKAZAKI et al., 2005-a; TEMPRADO et al., 1997).

Some authors have argued that elbow extension movement as a way to increase ball's impulse (BUTTON et al., 2003; KNUDSON, 1993). On the other hand, the movements around the wrist joint were more related to accuracy aspects of the shoot (MILLER & BARTLETT, 1996). The findings of the present study indicate that the three joints (shoulder, elbow and wrist) contributed to the increase ball's impulse, as they move in phase to generate high angular velocities. Daiuto (1971) proposed that this flexion must occur with a little lateral deviation and to take place after the complete extension of the elbow joint. The present study showed an opposite tendency where wrist flexion occurred before elbow extension. This supports the propositions of Okazaki et al. (2005-b) and Rodacki et al. (2005) that have demonstrated that wrist flexion occurs well before complete elbow extension (OKAZAKI et al., 2005-b; RODACKI et al., 2005).

The follow-through phase is determined by the instant in which the ball is released. This phase is characterized by the movement after final wrist flexion and movement deceleration (shoulder flexion and elbow extension) (OKAZAKI et al., 2005-b). The shoot is finished by elbow extension and with the hand parallel to the floor with the fingers pointed to direction of the basket (COLEMAN & RAY, 1976). Some studies showed that the angular values in the instant of release may vary from 113º (ELLIOTT e WHITE, 1989) to 148º (ELLIOTT, 1992) for the shoulder joint, 132º (ELLIOTT e WHITE, 1989) to 156º (ELLIOTT, 1992) for the elbow joint and between 179º (ELLIOTT e WHITE, 1989) for the wrist joint, which are different from those reported in this study (121º, 165º and 169º, for the shoulder, elbow and wrist, respectively). Chlidren is diferenciated just for the fact they performed a greater elbow extension, possible to increase the ball impulse.

CONCLUSION

The shoot coordination analysis showed that children used an “in-phase” movement accross the shoulder, elbow and wrist joints to release the ball. This strategy was verified because children were not able to take advantage of the eccentric-concentric cycle around the elbow to improve movement performance. As children were not able to to synchronize the angular peak velocities with the instant of ball release, greater values of velocity had to be generated. Therefore, more movement variability and a decrease in accuracy may had occurred. A greater peak elbow extension was also verified as strategy to increase the propulsion applied to the ball.

For future studies, it is recommended the use of more complex biomechanical models including the lower limbs. The influence of other variables (e.g. shoot distance, experience, displacements, fatigue) are also required.

REFERÊNCIAS

BUTTON, C.; MACLEOD, M.; SANDERS, R.; COLEMAN, S. (2003). Examining movement Variability in the Basketball Free-Throw Action at Different Skill Levels. **Research Quarterly for Exercise and Sport**, 74(03): 257-269.

COLEMAN, B. e RAY, P. **Basquetebol.** Coleção Desporto, Publicações Europa-América, 1976. Tradução de Adam Ribeiro de “Basketball (título original)” da “The English Basketball Association”.

DAIUTO, M. **Basquetebol: Metodologia de Ensino.** Editora Iglu, São Paulo, 3ª edição, São Paulo Brasil, total p. 417, 1971.

ELLIOTT, B.C. (1992). A Kinematic Comparison of the Male and Female Two-Point and Three-Point Jump Shots in Basketball. **The Australian Journal of Science and Medicine**, 24(04): 111-118.

ELLIOTT, B.C.; WHITE, E. A Kinematic and Kinetic Analysis of the Female Two Point and Three Point Jump Shots in Basketball. **The Australiam Journal of Science and Medicine in Sport**, vol. 21, nº 02, p. 7-11, 1989.

HUDSON, J.L. Shooting Techniques for Small Players. **Athletic Journal**, November, 22-24, Houstom - TX, 1985.

KNUDSON, D. Biomechanics of the Basketball Jump Shot Six Key Points. **Journal of Physical Education, Recreation, and Dance**, vol. 64, p. 67-73, 1993.

MILLER, S.A. e BARTLETT, R.M. The Relationship Between Basketball Shooting Kinematics, Distance and Playing Position. **Journal of Sports Sciences**, vol. 14, p. 243-253, 1996.

OKAZAKI, V. H. A. & RODACKI, A. L. F. **Changes in Basketball Shooting Coordination in Children Performing With Diferent Balls.** Fédération Internationale D'éducation Physique, vol. 75, nº 02, p. 368-371, 2005.

OKAZAKI, V.H.A.; RODACKI, A.L.F.; DEZAN, V.H.; SARRAF, T.A. Coordenação do Arremesso de Jump no Basquetebol de Crianças e Adultos. **Revista Brasileira de Biomecânica**, 2005-a *in press.*

OKAZAKI, V.H.A.; OKAZAKI, F.H.A.; LOPES, R.F.; CAÇOLA, P.M.; MEDINA, J.; REZENDE, G. A Coordenação do Arremesso de Jump no Basquetebol. In: Fórum Internacional de Qualidade de Vida e Saúde, 2005, Curitiba. **Revista Científica JOPEF**, vol. 02, p. 18-20, 2005-b.

OKAZAKI, V.H.A.; RODACKI, A.L.F.; SARRAF, T.A.; DEZAN, V.H.; OKAZAKI, F.H. Diagnóstico da Especificidade Técnica dos Jogadores de Basquetebol. **Revista Brasileira de Ciência e Movimento**, vol. 12, nº 04, p. 17-24, 2004-a.

RODACKI, A.LF.; OKAZAKI, V.H.A.; SARRAF, T.A.; DEZAN, V.H. O Efeito da Distância Sobre a Coordenação do Arremesso de Jump no Basquetebol. In: **XI Congresso Brasileiro de Biomecânica**, João Pessoa PB, 2005.

TEMPRADO, J.; DELLA-GRASTA, M.; FARREL, M.; LAURENT, M. A Novice-Expert Comparison of (Intra-Limb) Coordination Subserving the Volleyball Serve. **Human Movement Science,** vol. 16, p. 653-676, 1997.

BASKETBALL JUMP SHOOT COORDINATION IN CHILDREN

This study aimed to analyze the jump shoot coordination in children basketball's players. Eight children (10,0 ± 0,5 years; 2,25 ± 0,79 years of practice) were filmed (2D, 100Hz, sagittal plane) shooting to the basket. A biomechanical model was used to analyze angular displacement and velocity of the shoulder, elbow and wrist joints. Children used an “in-phase” movement across the joints (shoulder, elbow and wrist) to increase ball impulse at release. These strategy may be observed because children did not use a counter-movement around the elbow joint to optimize performance. A great joint angular velocity generation was verified, because children were not able to synchronize the peak velocities with the instant of ball release.

Key-Words: coordination and motor control, basketball shooting, children.

COORDINATION DE MOI LA LANCE DU JUMP DANS LE BASKET-BALL DES ENFANTS

Cette étude qu'elle objectified pour analyser la coordination de moi la lancent de sautez dans les enfants de pratique du basket-ball. Huit enfants (± 10.0 0.5 ans ; ± 2.25 0.79 ans de pratique) eu filmé (2D, 100Hz, plan sagittal) lançant au panier. Un modèle biomechanic a été employé pour analyser l'écart angulaire et la vitesse de l'épaule, coude et poing. Les enfants emploient un mouvement dans la phase dans les joints (épaule, coude et poing) pour produire de l'impulsion dans le lancement de la boule. On peut avoir observé cette stratégie parce que les enfants n'ont pas eu autour de de l'utilisation un countermovement du coude pour optimiser exécution. Une grande génération de vitesse dans les joints a été vérifiée, donc les enfants n'avaient pas été capables pour synchroniser les crêtes de la vitesse avec l'instant du lancement de la boule.

Mots-Clé: coordination et contrôle moteur, lance dans le basket-ball, enfants.

COORDINACIÓN DEL Mí LA LANZO DEL JUMP EN EL BALONCESTO DE NIÑOS

Este estudio que objectified para analizar la coordinación del mí la lanza de salte en niños practicantes del baloncesto. Ocho niños (± 10.0 0.5 años; ± 2.25 0.79 años de práctico) tenido filmado (2.o, 100Hz, plan sagital) que lanza a la cesta. Un modelo biomechanic fue utilizado para analizar la dislocación angular y la velocidad del hombro, codo y puño. Los niños utilizan un movimiento en fase en los empalmes (hombro, codo y puño) para generar impulso en lanzar de la bola. Esta estrategia puede haber sido observada porque los niños no tenían alrededor del utilizó un countermovement del codo para optimizar funcionamiento. Una gran generación de la velocidad en los empalmes fue verificada, por lo tanto los niños no habían sido capaces sincronizar los picos de la velocidad con instante de lanzar de la bola.

Palabras-Chávez: coordinación y control del motor, Lanzo en el baloncesto, niños.

COORDENAçãO DO ARREMESSO DE JUMP NO BASQUETEBOL DE CRIANçAS

Este estudo objetivou analisar a coordenação do arremesso de jump em crianças praticantes de basquetebol. Oito crianças (10,0 ± 0,5 anos; 2,25 ± 0,79 anos de prática) foram filmadas (2D, 100Hz, plano sagital) arremessando à cesta. Um modelo biomecânico foi utilizado para analisar o deslocamento e a velocidade angulares do ombro, cotovelo e punho. As crianças utilizam um movimento em fase nas articulações (ombro, cotovelo e punho) para gerar impulso no lançamento da bola. Esta estratégia pode ter sido observada porque as crianças não utilizaram um contra-movimento ao redor do cotovelo para otimizar a performance. Uma grande geração de velocidade nas articulações foi verificada, pois as crianças não foram capazes de sincronizar os picos de velocidade com o instante de lançamento da bola.

Palavras-Chaves: coordenação e controle motor, arremesso no basquetebol, crianças.