168 - BASKETBALL SHOOT AND PLAYERS HEIGHT

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INTRODUCTION

The release angle, velocity and height have been considered the determinant factors of the basketball shoot (MILLER & BARTLETT, 1993, 1996). Release angles that provide little velocity generation have been suggested (BRANCAZIO, 1981), because velocity is right related to movement variability (SCHMDIT et al., 1978, 1979; TEIXEIRA, 1999). Thus, great release heights should be pursued by players to decrease the distance that the ball must to travel and, hence, the release angle and velocity (KNUDSON, 1993). The height of release may be influenced by the jump, shoulder flexion, elbow extension, trunk inclination and players height. These, players height seemed to be the factor that most influences the release height (KNUDSON, 1996). Therefore, players with different heights may demand particular performance in the shoot (HUDSON, 1985b; OKAZAKI et al., 2006). However, it is not clear the differences in the shoots performed by players with different heights.

The present study aimed to compare the shoot kinematics in basketball players with different heights. These analyses may provide a better understanding of the movement strategies of adopted by players with different heights to optimize shoot performance.

METHODOLOGY

Sample

Sample was composed by six basketball male players (right handed) divided in a group with greater height with 2,0 ± 0,12 m (3 subjects; 26,3 ± 9,3 years old; 98,3 ± 19,3 kg; experience 16,3 ± 5,9 years) and minor height with 1,75 ± 0,06 m (3 subjects; 23,0 ± 1,7 years old; 74,0 ± 11,5 kg; experience 12,3 ± 1,2 years old). Before the analysis started, all subjects were informed by the evaluation procedures needed for the study an assigned a free and clear agreement term.;

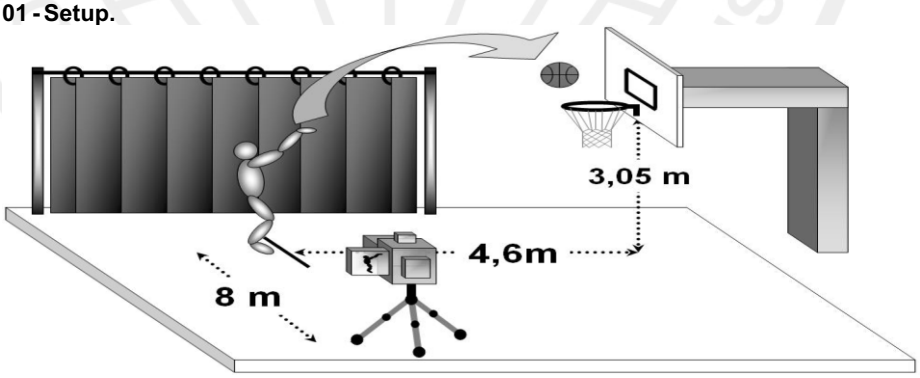
Experimental Procedures

Before the beginning of the record, a warm up was performed with generalized exercised (15 minutes). The warm up was not controlled and each participant was free to choose its own series of exercise to avoid fatigue. After, subjects were marked by an only expert evaluator, while they were informed of the experimental procedures. Later, subjects practice shoots of freethrow (2-5 minutes) from a perpendicular and frontal position (figure 01). Three movement selected were extracted randomly from a conjuct of ten shoots well succeeded (shoots that ball pass within the ring without touch the chart). Three recorded shoots were grouped to compose a mean and represent the movement pattern of each subject. The movement beginning was determined in the instant in which subject started to lift up the ball (through a shoulder or elbow flexion). The end of movement was determined by the release instant (when the ball loses the contact with the hand).

Shoots coordination was analyzed from the relative movements of the shoulder, elbow, and wrist joints. These joints movements were quantified through a kinematic analysis. For such, the video camera (Panasonic - Palmcorder-VHS de 60 Hz - Shutter Speed de 1/250) used was perpendicular positioned in relation to the movement plane with the focal center directed to shoulder joint. Video camera was positioned at the right subjects side, with a distance of 8 m from the movement plane.

As shoot is predominantly performed in only one plane of movement (saggital), a two dimensional analysis has been considered adequated (OKAZAKI & ROADCKI, 2005; BUTTON et al., 2003; KNUDSON, 1993). For a better visualization of the movement, a black screen was put at the left side of the subject. Thus, it was provided a deep plane that contrasted with the markers (with white color) used in the biomechanical model, making easier the process of tracking (digitalizing). A schematic representation of the film setup was expressed in figure 01.

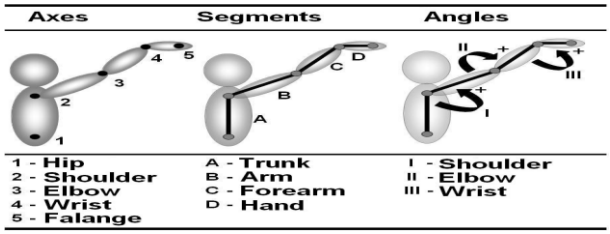
Figure 01 - Setup.



Biomechanical Model

To assess movement performance, a set of markers (diameter = 15 mm) was fixed on the skin in the following anatomic landmarks: (1) hip - iliac crist; (2) shoulder - shoulder center joint (2-5 cm bellow acromio); (3) elbow - humerus lateral epicondilos; (4) wrist - ulna stiloid process; and (5) fifth falange joint axis - fift metacarpal-falange. This set of anatomic marks was used to define the trunk (1-2), arm (2-3), forearm (3-4) and hand (4-5). The connection formed by two adjacent segments was used to calculate joint angles.

Figure 02 - Biomechanical Model.



Images were stored in tape and then transferred to a computer throught a analog-to-digital converter (Belkin - USB, F5U208, USA). Markers were digitalized (tracked) through specific movement analysis software (Dgeeme, v.0.98b) and a set of coordinates was obtained. The coordinates were filtered with a Butterworth recursive filter (4th order) with a cutoff frequency of 10 Hz (Winter, 1990) performed through the angular displacement and velocity of the elbow from one subject. To reduce subjects' intra- and inter-variability, data were normalized in relation to the time-cycle of the movement, in other words, the movements were expressed in relative values. This procedure is performed through a spline function (OKAZAKI et al., 2005; RODACKI et al., 2005).

Study variables

Shoot coordination was analyzed through the profile of angular displacement and velocity joints in function of the movement time. A longitudinal data analysis was used to show the instant in which the shoot cycle where were found differences in the variables of the angular displacement and velocity between children and adults. The relationship analysis between the profile of angular displacement adjacent joints (shoulder-elbow and wrist-elbow) from adults and children was also analyzed.

Statistical Analysis

Dada was analyzed through descriptive statistics of mean and standard deviation. Kolmogorov-Smirnov test was used to confirm the data normality. To compare the profile of the angular displacement and velocity between players with more and less height, it was used a longitudinal data analysis. This was performed through the construction of interval of confidence for 95%, during the hole cycle of movement. This procedure was already performed in other studies (OKAZAKI et al., 2005a; TEIXEIRA et al., 2003). The significance level adopted was $p<0.05$. The statistical analysis was performed through the software Statistica® (Statsoft Inc. v.6.0). A reproducibility test from the kinematic analysis that envolved three digitalizing of the same shoot in one of the experimental conditions showed an angular error of 2.2º, 2.2º and 1.5º, respectively to shoulder, elbow, and wrist joints.

RESULTS

There were no significant differences in the variables of angular displacement and velocity between players with high and low height (Figure 03).

Subjects with high and low height showed a movement between shoulder and elbow at the beginning phase of shoot, where both joints were flexed simultaneously. At the propulsion phase, it was also observed a synchronized movement between these joints, where elbow was extended and shoulder was flexed. During the propulsion phase, it was observed dominance at the angular displacement of the elbow over shoulder. The wrist-elbow relationship showed at the beginning of movement little displacement variation on wrist joint, while elbow was flexed to positioned the ball. Following, elbow stared to decelerate flexion movement for the wrist performed the extension. After, a reciprocal movement was observed to release the ball, in which elbow performed an extension and wrist a flexion. The coordination analyzed through the relationship between the adjacent joints of the players with high and low height was expressed in Figure 04.

Figure 3 - Angular Displacement and Velocity.

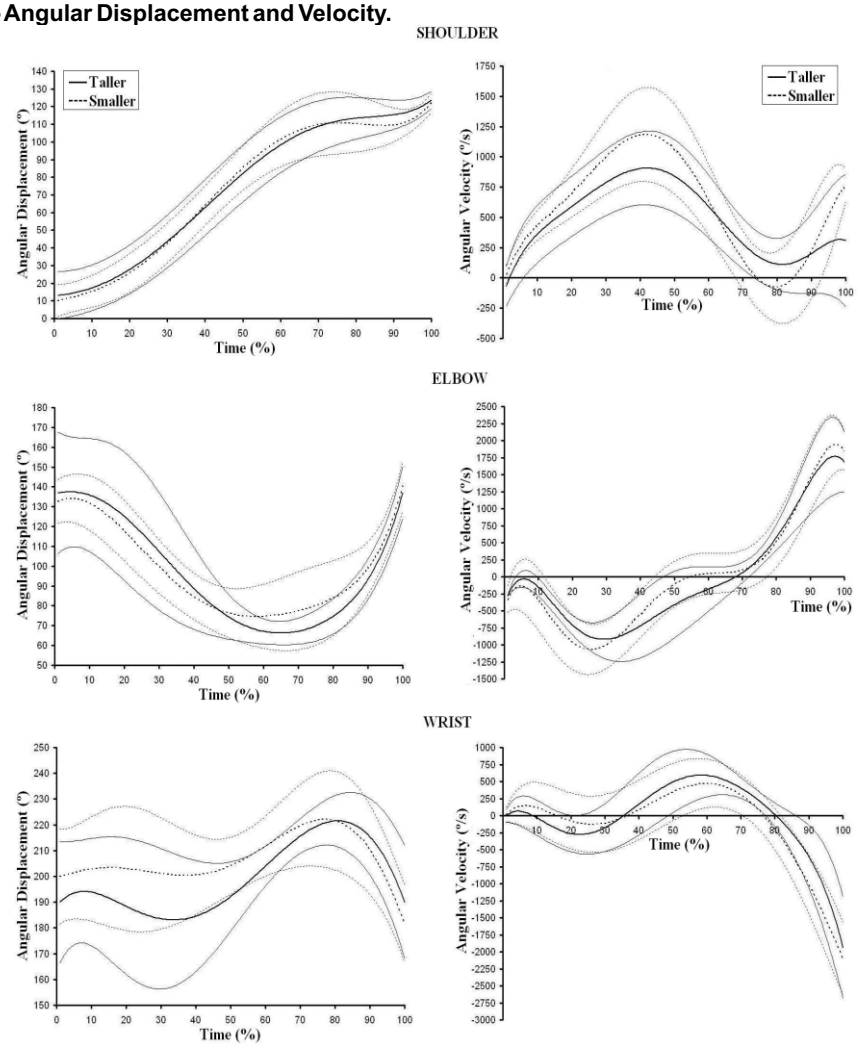
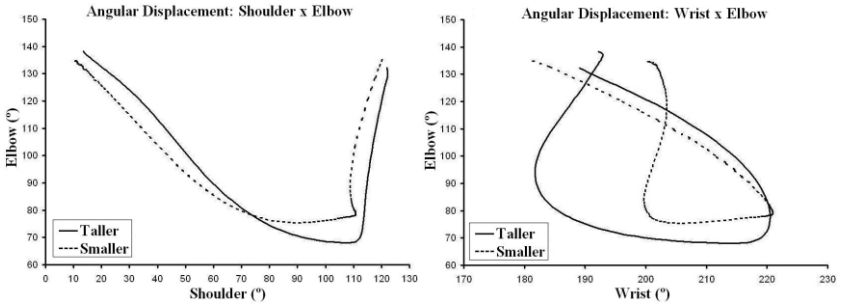


Figure 04 - Angular Displacement Between Adjacent Joints.



DISCUSSION

The basketball coordinative pattern of shoot showed to be consistent independently of the player height. Thus, in expert players only the control parameters seemed to be adapted to accomplish a well succeed shoot. However, these founds are not in consonance with other studies that argue the effect of experience and players' height during the shoot performance (HUDSON, 1982, 1985a, 1985b).

Hudson (1982, 1985a) showed that release height is one of the most determinant parameters for the differentiation of players experience. Because, low height of release needs greater generation of force and velocity to provide impulse to throw the ball (KNUDSON, 1996), and both are inversely related to less accuracy of movement response (SCHMIDT et al., 1978; TEIXEIRA, 2000). Theses hypothesis have support on the findings of Okazaki et al. (2006) that verified greater elbow extension and greater shoulder velocity during the shoot performed by children in comparison with adults. Nevertheless, the results of the present study suggest that the differences found on the studies of Hudson (1982, 1985a, 1985b) seemed to be more related to players experience, while the study of Okazaki et al. (2006) would be more associated with experience and the capacity to generate force, in comparison with the height of balls release.

The profile of the angular displacement between the adjacent joints reinforced the proximity between subjects with high and low height. However, the transition between the instant of elbow flexion-extension movement at elbow and extension-flexion at wrist presented a profile smoothed for the shoots performed by the players with high heigh. This suggests that players with greater height have less necessity to enjoy the energy of a counter-movement around the elbow and wrist joints. These results are in consonance with other studies that attribute greater release height a minor necessity to generate force, in relation to the less distance traveled by the ball in the direction to the basket (HUDSON, 1985b; KNUDSON, 1996; MILLER & BARTLETT, 1996). This absence of the strategy of a counter-movement in basketball shoot has also been reported by other authors (BUTTON et al., 2003).

In other way, players with low height showed a profile of change more abrupt at the flexion-extension transition of the elbow and at the extension-flexion of the wrist. Thus, players with low height seemed to take more advantage of the counter-movement around the elbow and wrist joints. Maybe, this strategy adopted by players with low height helped at the balls generation of impulse without the necessity to generate more velocity around the joints during the balls release.

CONCLUSION

Subjects with low height seemed to use more the energy produced through a counter-movement around the elbow and wrist to generate impulse during balls release. However, the coordination adopted by subjects did not showed to be different in function of the player height, where only the control parameters were particular. Therefore, an usual movement pattern of shoot on basketball may be reference at the process of teach-learning between players with different heights.

For future studies, it is recommended to analyze the shoot on basketball in relation to player height with other indicators of the shoot, such as: center of mass and height, angle and velocity of the ball during the release. It is also advised to analyze the effects of other variables over the performance of shoot, like: experience, anthropometrical characteristics, distance of the shoot, etc.

REFERENCES

BRANCAZIO, P.J. Physics of Basketball. American Journal of Physics, vol. 49, p. 356-365, 1981.

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

CROSSMAN, E.R.F.W. e GOODEVE, J. Feedback Control of Hand-Movement and Fitts' Law. Quarterly Journal of Experimental Psychology, vol. 35A, p. 251-278, 1983.

ELLIOTT, B.C. e 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.. Prediction of Basketball Skill Using Biomechanical Variables. Research Quarterly For Exercise and Sport, vol. 56, nº 02, p. 115-121, 1985a.

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

HUDSON, J.L. A Biomechanical Analysis by Skill Level of Free Throw Shooting in Basketball. International Symposium of Biomechanics in Sports, p. 95-102, San Diego-CA, 1982.

MALONE, L.A.; GERVAIS, P.L.; STEADWARD, R.D. Shooting Mechanics Related to Player Classification on Free Throw Success in Wheelchair Basketball. Journal of Rehabilitation Research and Development, Nov/Dez, vol. 39, nº 06, p. 701-709, 2002.

MILLER, S.A. e BARTLETT, R.M. The effects of Increased Shooting Distance in the Basketball Jump Shot. Journal of Sports Sciences, vol. 11, p. 285-293, 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.

NUNOME, H.; DOYO, W.; SAKURAI, S.; IKEGMAI, Y.; YABE, K. A Kinematic Study of the Upper-Limb Motion of Wheelchair Basketball Shooting in Tetraplegic Adults. Journal of Rehabilitation Research and Development, vol. 39, n° 1, p. 63-71, 2002.

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, 2006 *in press*.

OKAZAKI, V. H. A. e 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.; 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, n°04, p. 17-24, 2004.

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.
SATERN, M.N. Basketball: Shooting the Jump Shot. Strategies Performance Excellence. Mar., p. 9-11, 1988.
SCHMIDT, R.A.; ZELAZNIK, H.N.; FRANK, J.S. Sources of inaccuracy in rapid movement. In: G.E. Stelmach (Ed.), Information processing in motor control and learning. New York, Academic Press, p.183-203, 1978.
SCHMIDT, R.A.; ZELAZNIK, H.; HAWKINS, B.; FRANK, J.S.; QUINN, J.T. Motor-output variability: A theory for the accuracy of rapid motor acts. Psychological Review, 86(5), 415-451, 1979.
TEIXEIRA, L.A. Sobre a Generalidade de Estratégias de Controle Sensório Motor. Revista Paulista de Educação Física. vol 03, p. 89-96, 2000.
TEIXEIRA, L.A. Kinematics of Kicking as a Function of Different Sources of Constraint on Accurancy. Perceptuals and Motor Skills, vol. 88, p. 785-789, 1999.
TEIXEIRA, F.G.; SANTIAGO, P.R.P.; CUNHA, S.A. Comparação do Chute no Futebol Entre Duas Categorias Distintas Utilizando Coordenadas Esféricas. Revista Brasileira de Biomecânica, vol. 04, n° 07, p. 41-50, 2003.

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BASKETBALL SHOOT AND PLAYERS HEIGHT

ABSTRACT
The present study aimed to compare the basketball jump shoot coordination of players with higher and lower height. Three basketball players with higher height (2,0 ± 0,12 m; experience 16,3 ± 5,9 years) and three with lower height (1,75 ± 0,06 m; experience 12,3 ± 1,2 years) were analyzed cinematically (2 D, 60 Hz, saggital plane) performing freethrow shoots. A biomechanical model (6 points determining 4 body's segments) provided the angular displacement and angular velocity of the shoulder, elbow and wrist. Angular displacement and velocity behavior was compared through confidence intervals of 95% during the whole movement cycle. Players with lower height seemed to optimize the counter-movement strategy around the elbow and wrist joints to release the ball. However, the coordination adopted between the players was not different in relation to the height, where only the control parameters were different. Thus, a common movement pattern is proposed in basketball shoot as a reference in the process teach-learning between players with different heights.
KEY -WORDS: Basketball Shoot, Height, Motor Coordination.

TIR DE BASKET-BALL ET TAILLE DE JOUEURS

RESUMÉ
La présente étude a visé à comparer la coordination de pousse de saut de basket-ball des joueurs à une taille plus élevée et inférieure. Trois joueurs de basket-ball avec une taille plus élevée (± 2.0 0.12 m ; éprouver 16.3 le ± 5.9 ans) et trois avec la taille inférieure (± 1.75 0.06 m ; le ± 12.3 d'expérience 1.2 ans) ont été analysés cinematically (2 D, 60 hertz, avion saggital) exécutant des pousses de freethrow. Un modèle biomécanique (6 points déterminant 4 segments du corps) a fourni l'écart angulaire et la vitesse angulaire de l'épaule, du coude et du poignet. Le comportement d'écart angulaire et de vitesse a été comparé par des intervalles de confiance de 95% pendant le cycle entier de mouvement. Les joueurs avec la taille inférieure ont semblé optimiser la stratégie de compteur-mouvement autour des joints de coude et de poignet pour libérer la boule. Cependant, la coordination adoptée entre les joueurs n'était pas différente par rapport à la taille, où seulement les paramètres de commande étaient différents. Ainsi, on propose un modèle commun de mouvement dans la pousse de basket-ball comme référence dans le processus enseigner-apprenant entre les joueurs avec différentes tailles.
MOTS CLES : Pousse de basket-ball, taille, coordination de moteur.

EL TIRO DEL BALONCESTO Y LA ALTURA DE LOS JUGADORES

RESUMEN
Este estudio objetivo comparar la coordinación de él lanza de salto en el baloncesto de jugadores con estaturas mayores y menor. Tres atletas del adulto de baloncesto con estatura mayor (± 2.0 0.12 m; experimente 16.3 el ± 5.9 años) y tres con estatura menor (± 1.75 0.06 m; experiencia 12,3 ± 1,2 anos) era analizado por cinemática (los 2.o, 60 hertzios, plano saggital) realizando lanzamientos del lance libre. Un modelo biomecánico (6 puntos que determinan 4 segmentos del cuerpo) proporcionó la dislocación angular y la velocidad angular de el hombro, el codo y el puño. El comportamiento de la dislocación angular y de la velocidad fue comparado con intervalos de la confianza del 95% durante el entero ciclo del movimiento. Los atletas con menor altura parecían optimizar la estrategia del contra-movimiento alrededor del codo y del puño para lanzar la bola. Mientras que, la coordinación adoptada por los atletas no era diferente en la consideración a la altura del jugador, donde solamente era adaptado detalles en los parámetros del control. Así, una estrategia común del movimiento se propone en lanzamiento del baloncesto como referencia en el proceso del enseñar-y-aprender entre los jugadores con diversas alturas.
PALABRAS-CLAVES: Lanzamiento del baloncesto, altura, coordinación motora.

ARREMESSO NO BASQUETEBOL E A ESTATURA DO JOGADOR

RESUMO
O presente estudo objetivou comparar a coordenação do arremesso de jump no basquetebol de jogadores com maior e menor estaturas. Três atletas de basquetebol adultos com maior estatura (2,0 ± 0,12 m; experiência 16,3 ± 5,9 anos) e três com menor estatura (1,75 ± 0,06 m; experiência 12,3 ± 1,2 anos) foram analisados cinematicamente (2 D, 60Hz, plano sagital) realizando arremessos de lance livre. Um modelo biomecânico (6 pontos definindo 4 segmentos do corpo) forneceu os deslocamentos e velocidades angulares da articulação do ombro, cotovelo e punho. Para comparar o perfil do deslocamento e velocidade angular de homens e mulheres, foram criados intervalos de confiança para 95% durante todo o ciclo do movimento. Os sujeitos com menor estatura parecem otimizar a estratégia do contra-movimento ao redor da articulação do cotovelo e punho para lançar a bola. Todavia, a coordenação adotada pelos sujeitos não demonstrou ser diferenciada em função da estatura, onde apenas os parâmetros de controle foram particulares. Desta forma, um padrão de movimento comum é sugerido no arremesso de basquetebol como referência no processo ensino-aprendizagem entre atletas com diferentes estaturas.
PALAVRAS-CHAVE: Arremesso de Basquetebol, Estatura, Coordenação Motora.