107 - ANALYSIS OF DIFFERENT HANDBALL THROWING FROM THE BALL AND SEGMENTS VELOCITIES ON

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1. Introduction

In Sports as baseball, American soccer, aquatic polar region, launching of dart and handball, the technique of the throwing on the shoulder is of basic importance so that the athlete reaches the success in the execution of the gesture. Diverse studies have shown that I hurl it involves a sequential action of corporal segments, progressing of ample actions of proximal segments for faster and relatively lesser actions of the segments distal (Atwater, 1980; Muller, 1982; Kreighbaum et al, 1981; Zatsiorsky, 1981; Sakurai et al, 1983; aprí Jóris, 1985). The sequences of action of the throwing in general are, mainly: rotation of trunk, internal rotation and/or horizontal flexion of the shoulder, extension of the elbow and flexion of fist (Ball, 2000).

The joined research that involves analysis of the technique of I hurl mention baseball to it, aquatic polar region and to the American soccer (Rash, 1992; Fleisig et al, 1996; Feilner, 1997; Sherwood, 1997; Andrews, 1999), while that research that mentions handball to it studies that still describe the kinematics and/or the kinesiology or the used types of methodology for this type of analysis (Baylos, 1998; Andrzej, 1998; Loss et al, 1999). A lack of literature with regard to studies exists that make an analysis of the technique of hurl it and its correlation with the speed of the ball applied to handball.

In that if it relates to the mechanics of I hurl it, associated to the speed of the ball, he is generally accepted that a deceleration of proximal segments is preceding and even though. Causing of an acceleration of distal segments, where the maximum speed of segment caused for the activity of the agonist muscle of a joint must be decelerated by the antagonistic muscles of this same joint to speed up distal segments (Jóris, 1995). These communications contradict the principle of the optimization formulated for Hochmuth apud Jóris, 1989, where all the end speeds must be maximum in one single instant of time.

The objectives of this study had been to correlate the instants of peaks of speed of the segments forearm and hand and the maximum speed of ball in four different types of I hurl, comparatively.

2. Materials and Methods

The sample was composed of athlete of Handball of IV the Games of the Youth of 1998 (n=43) with average age of 15.6 (0.6) years, having been collected three types of throwing (in projection, in suspension and shot of 7m) and Youthful athletes of the club Recreation of Youth in 2002 (n=15) with average age of 14.9 (0.8) years, being that in this group they had been carried through only throwing in support and projection. All the 58 athletes were of the masculine sex. I hurl it in projection was characterized by a daily pay-race of the followed athlete of a jump for front in the instant of I hurl it; I hurl it in suspension was characterized by a similar standard to the previous one except in relation to the direction of the jump that was for top; I hurl it in support was characterized by the same displacement of the previous throwing, however without the use of jumps immediately before I hurl it, e I hurl it of seven meters was characterized by having been carried through with one of the feet fixed on the mast of seven meters. The kinematics variable, displacement and linear speed had been measured from the filming of the throwing with use of the System of Video 2D Peak Performance Version 5.3 (Peak Incorporation Performance - U.S.A.). The camera was located in way that its optic axe was perpendicular to the sagittal plan of the individual. An observer was located behind the region of hurlers in order to be able to evaluate the perpendiculurities of hurl of the optic axe of the camera. When necessary I hurl it was repeated. Moreover, an extra camera was located frontal to hurl it in a high position (approximately 7 meters above of the collection place) to certify the direction of hurl it, as well as the position of hurlers in relation to the other camera. Throwing in oblique directions to the axe had been discarded.

The anatomical points had been located in each individual in the height of the stoid process of ulna next to the joint to the fist, representing the distal position of forearm and in the proximal phalanx of the average finger of the hand of I hurl, representing the position of the hand. For this procedure the adhesive reflexives ribbon ad was necessary, except for the ball, therefore its rotation would directly cause errors in the localization of the object in the film, affecting the calculation of the speed. The position data had been filtered in a Butterworth filter of the order: pass-low of 15 Hz. From the positions of the points, the attainment of the speeds of the interest segments, it gave for double described derivation as for Andrews (1974). The sampling frequency was of 120 Hz. It is important to point out that the time of duration of analysis of the throwing never was inferior the 0.06 seconds, thus allowing that a number of at the very least 6 picture was used for the calculations of the speeds. The seven meters of the point of I hurl was placed an official goal with net so that the ball was cushioned, since all the collection of data was carried through inside of a laboratory. With intention to speed the execution of the tests, the markers, they had been imprisoned with aid of munhequeiras for the fist and latex for the finger. With exception of I hurl it of seven meters, all the others could be preceded of bounce of the ball (characteristic gesture of the sport), being the decision the criterion of the athlete. Common one to the sport was not allowed one practical, to coat the ball with glue in order to improve its tack with the hand, therefore this would modify the contrast of the ball (always while disabling a necessary analysis of the event for the video system. Beyond the kinematics data som
antropométricas 0 variable had been also measured as: corporal mass, stature, and spread, through one balance of the mark Filizola-Modelo 31, one estadiometer connected to the scale and a milimetre picture of the Arch mark, both with resolution of 1mm. For the comparison it enters all the types of collected throwing was made the test One Way ANOVA and Post Hoc de Tukey.

3. Presentation and quarrel of the results

The respective averages had been verified and the shunting line-standard for each type of hurl for maximum speed of ball, maximum speed of fist (linear speed of forearm in its distal extremity) and maximum speed of finger (linear speed of the hand), these data are presented in Figure 1. The values show for all the types of throwing speeds of inferior fist the finger speeds, that are inferior the ball speeds. The fist speeds are minors who of finger in function of the lesser distance of the point of analysis in relation to the axle to articulate. Already the difference enters the finger speeds and ball is small, therefore the point of the monitored finger was next to the center to the ball.

For the fact of the hand to be located more distalmente in relation to forearm, is of if waiting that it has a difference in the linear speed between these colon. From the antropométricos data, one evidenced that the point located in the average finger was in distal average 15% of the joint of the shoulder that the point located in the fist. Comparing it speed of the hand with the speed of forearm notices a always superior difference 32% in the different throwing in function of its respective distances in relation to the axle to articulate of the shoulder, suggesting that the remain of the speed contribution is origin of the flexion of the fist.

![Figure 1 - Average and shunting line standard in all the throwing for maximum speed reached for the segments forearm (fist) and hand (finger) and ball.](image)

In Table 1 it was compared maximum speed of ball reached with all the types of collected throwing. It had significant difference of these speeds between the throwing with displacement (suspension, projection and support) for I hurl it of seven meters. It can be inferred that the throwing in displacement had reached greater ball speeds, for they make possible a bigger transference of energy of the inferior members and trunk for the superiors.

<table>
<thead>
<tr>
<th></th>
<th>Suspension</th>
<th>Projection</th>
<th>Supported</th>
<th>Seven meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspension</td>
<td>X</td>
<td>0.110</td>
<td>0.640</td>
<td>0.045*</td>
</tr>
<tr>
<td>Projection</td>
<td>0.110</td>
<td>X</td>
<td>0.998</td>
<td>0.000*</td>
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* estatistically significant (p<0.05)

Figures 2 and 3 show two throwing in suspension respectively, where in the first one if it almost has the maximum speed of reached hand and finger in the same instant of time, or either, 0.008s (1quadro) of difference, while in as I hurl, the time difference enters the maximum speeds of segments is superior 0.033s (4 pictures).

![Figure 2 - I hurl in suspension with maximum speeds of segments reached in next instants to time](image)
The analysis of Figures 2 and 3 allows to infer that to reach speeds of segments in one same instant of time or very next instants of time it necessarily does not mean to reach greater ball speeds, what it collates the proposal of Hochmuth, therefore I hurl it that it showed a bigger distance of time enters the maximum speeds of forearm and hand reached values of linear speed of bigger ball. According to Eliaasz (1993), the most important factor to determine the speed of the ball during I hurl it of shoulder is the maximum speed of the arm, however the maximum angular speed of the arm and the force of the flexors of trunk (abdominal muscles) also produce decisive effect on the speed of the ball. Roberts apud Andrews, 1999 evidenced that a thrower with triceps paralyzed is capable to launch a ball more than 80% of the speed reached before the paralysis. Toyshima apud Andrews, 1999, compared throwing of complete form with throwing that had as only action the extension of the elbow and flexion of fist, the results had shown that the speed of ball reached for I hurl it complete is the double of the speed of the other I hurl, affirmations that also corroborate the idea of that all the corporal segments contribute with the gesture to hurl. The same author still affirms that the elbow contributes with less than 43% of the speed of the ball and that the percentile greater of contribution is deriving of the trunk.

In players of the elite of aquatic polar region, the fastest throwing develops rotation of hip followed of shoulder rotation. Throwing slower develops hip rotation and shoulder rotation at the same time or does not develop hip rotation during hursts it, thus suggesting that a sequence of adjusted muscular activation is basic to reach bigger speeds of ball when hurling. In the throwing analyzed in this study the peak of speed of forearm always occurred before the peak of speed of the hand, suggesting carrying a sequential action of muscular activation, ratifying the affirmations of Atwater apud Morris, 1996.

4. Conclusions

It was evidenced from the presented methodology that the throwing with displacement has significantly bigger average maximum speeds in relation to hurl it of seven meters, carried through without displacement. (p<0.05). When analyzing throwing that had reached maximum speeds of segments in one same instant of time with throwing that had not presented this characteristic saw that the biggest speeds of ball if had given for those where it had a bigger interval of time enters the maximum speeds of segments, what it corroborates with the theory of that stops hursts it excellent must exist a sequence of muscular actions, leaving of amplier actions of bigger and proximal segments for lesser actions of distal segments.

5. Bibliographical references

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RASH, G.; SHAPIRO, R. Three Dimensional Kinetic Analysys of the Throwing Motion in Eight Elite
ANALYSIS OF DIFFERENT HANDBALL THROWING FROM THE BALL AND SEGMENTS VELOCITIES ON

Abstract:
The purposes of this paper were to make a temporal analysis between the peak velocities of different segments and the maximal velocity of the ball and to compare the velocities of the ball of four kinds of throwing. A kinematics analysis of four throwing was made: jump shot, projection, support and penalty throw. Throwings with displacement showed higher maximal ball velocities. Throwings that reached the maximal ball velocities were at higher time interval between the maximal segment velocities.

Key Words: Handball, Throwing, and Kinematics

ANALYSE DE HANDBALL DIFFÉRENT JETANT DE LA BOULE ET DES VITESSES DE SEGMENTS DESSUS

L’Abrégé:
Les buts de cet article étaient faire une analyse temporelle entre les vitesses maximales de différents segments et la vitesse maximale de la boule et de comparer les vitesses de la boule de quatre genres de lancer. Une analyse de cinématique de quatre jetant a été faite : jet de projectile, de projection, de soutien et de pénalité de saut. Throwings avec des vitesses maximales plus élevées de boule montrées par déplacement. Throwings qui a atteint les vitesses maximales de boule étaient celui de l’intervalles de grand temps entre les vitesses maximales de segment.

Mots-clés : Handball, lancement, et cinématique

ANÁLISIS DEL LANZAMIENTO DEL BALONMANO A PARTIR DE LAS VELOCIDADES DE SEGMENTOS Y PELOTA

Resumen:
Los objetivos de este estudio fueron presentar un análisis temporal entre los picos de velocidad de distintos segmentos y la velocidad máxima de la pelota y comparar las velocidades de pelota de cuatro modos de lanzamiento. Fue hecho un análisis cinemático de lanzamientos en situaciones de infiltración, suspensión, dislocación sin salto y penalit. Los lanzamientos con dislocación presentaron velocidades máximas de pelota mayores. Lanzamientos que alcanzaron las velocidades máximas de pelota fueron aquellas de mayores intervalos de tiempo entre las velocidades máximas de segmentos.

Palabras-clave: Balonmano, Lanzamiento y Cinemática

ANÁLISE DA VELOCIDADE DE SEGMENTOS NOS MEMBROS SUPERIORES E VELOCIDADE BOLA EM ARREMESSOS DO HANDEBOL

Resumo:
Os objetivos deste estudo foram correlacionar os instantes de picos de velocidade dos segmentos inteira e mão e a velocidade máxima de bola e comparar as velocidades de bola de quatro tipos de arremesso. Foi feita uma análise cinemática de arremessos em projeção, suspensão, apolo e sete metros. Arremessos com deslocamento possuem velocidades máximas de bola maiores. Arremessos que atingiram as máximas velocidades de bola foram aqueles de maior intervalo de tempo entre as máximas velocidades de segmentos.

Palavras Chaves: Handebol, Arremesso e Cinemática.