Biomechanics Modeling to Evaluate the Performance Level of Skill Correction Jump of the Junior Handball Players

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Abstract: The research aims at doing a biomechanical modeling to evaluate performance level of the skill of aiming by jump among handball young players. The researcher adopted the descriptive survey method by using video camera and computer analysis through K1-3D program. The research sample for both fundamental and investigation studies was taken from players of super tournament of Assiut governorate. The sample contained 6 players skilled at aiming by high jump and aiming by front jump. Physical dynamic analysis was done using video and computer program (K1-3D) at the dynamic analysis laboratory of the Faculty of Physical Education, Assiut University. The most important result was that physical ability contributed by 64.521% in the accuracy of performing the skill of aiming by front jump among the basic study sample. The variable of handball passing on the wall is considered the physical variable most related to the accuracy of performing the skill of aiming by front jump among the basic study sample since its percentage of contribution reached 67.813%.

Key words: Biomechanics • Handball • Training

INTRODUCTION

Studying and evaluating physical movements can be done through three fundamental aspects (psychological, physiological and biomechanical). The last aspect is considered the most valuable, as being distinguished with subjectivity of evaluation for it depends on a number of quantitative variables such as time – space – velocity – force – dynamic path in studying physical movements; particularly those skills that require speed to be performed the matter that urged the researcher to attempt setting biomechanical patterns through using various statistical methods for some performance skills (aiming by high jump- aiming by front jump) in accordance with different variables such as biomechanical variables and physical abilities [1].

These variables are used to contribute in understanding these performances and practicing the effect of changing any of these variables or the other variables and consequently evaluating the Performance in order to direct the training towards a great performance. The research aims at doing a biomechanical patterning to evaluate performance level of the skill of aiming by jump among handball young players in order to recognize:

- Biomechanical variables and physical abilities of the aiming skill (aiming by high jump and aiming by front jump).
- Nature of the relationship between biomechanical variables and physical abilities and accuracy level of the skills of aiming by high jump and aiming by front jump.
- Identification of biomechanical patterns for some aiming performances with regard to biomechanical variables and physical abilities via using some predictable equations.

Research Inquiries:

- What are the biomechanical variables, physical abilities of the aiming skill (aiming by high jump and aiming by front jump)?
- What is the relationship between biomechanical variables, physical abilities and the level of accuracy for the skill of aiming by high jump and aiming by front jump?
**MATERIALS AND METHODS**

The researcher adopted the descriptive survey method by using video camera and computer analysis through K1-3D program. The research sample for both fundamental and investigation studies was taken from players of super tournament of Assiut Governorate. The sample contained 6 players skilled at aiming by high jump and aiming by front jump.

From Table 1 we can recognize the arithmetic average, standard deviation, moderator and inflection coefficient of the basic variables and that this infection is confined to ±3 which prove that the data is correct and free of distribution faults.

From Table 2, we can recognize the arithmetic average, standard deviation, moderator, inflection coefficient of the physical variables (force, ability, fitness, muscular endurance, balance, compatibility and flexibility) and that this inflection is confined to ±3 which confirms the accuracy of data and compatibility of the sample with these physical variables.

**RESULTS AND DISCUSSION**

Table 3 indicates the differences in the resultant averages of displacement, velocity and acceleration for the skills of aiming by high jump and front jump during the three stages of performance.

Results presented in Table 4 show differences between the resultant averages (push and force) for the body's center of gravity during stages of performing the skill of aiming by high jump and aiming by front jump.

**First:** Preliminary stage including (receiving the ball – approaching) during performing the skill of aiming by high jump.

Primary stage including (connection interruption – utmost height – leaving the ball and aiming): average total time of performance during the stage of interrupting connection with the ground was (1.08sec) – resultant average displacement (226.1cm) – resultant average velocity (400.7 cm/sec) – resultant average acceleration (5421.8 cm/sec²). Stage of utmost height for the body's center of gravity during performance: average time of performance reached (1.4sec) – resultant average displacement (325.4cm) – resultant average velocity (409.2 cm/sec) – resultant average acceleration (2089.7 cm/sec²). Stage of leaving the ball: average time of performance (1.6sec) – resultant average displacement (24.5cm) – resultant average velocity (870.1 cm/sec).

**Second:** Stages of performance concerned with the skill of aiming by high jump.

Stage of leaving the ball or aiming: average time of performance reached (1.6sec) – out of total time for performance - resultant average displacement (99.7cm) – resultant average velocity (388.6cm/sec) – and resultant average acceleration (970.1 cm/sec²). Stage of leaving the ball: average time of performance (1.6sec) – resultant average displacement (24.5cm) – resultant average velocity (870.1 cm/sec).

Table 5 Indicates that the total number of significant correlation coefficients reached 32, varied from proportional correlation coefficients (positive) and non-proportional correlation coefficients (negative). The total number of proportional coefficients was 20 and non-proportion coefficients were 12 since these coefficients varied during the three stages of performance.
Table 3: Differences among resultant averages (displacement, acceleration and velocity) of the body's center of gravity for the skills (aiming by high jump and aiming by front jump) during stages of performance.

<table>
<thead>
<tr>
<th>Stages of performance</th>
<th>Parts of performance</th>
<th>Time</th>
<th>D</th>
<th>V</th>
<th>A</th>
<th>D</th>
<th>V</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary stage</td>
<td>-receiving the ball</td>
<td>0.16</td>
<td>-151.1</td>
<td>217.1</td>
<td>847.4</td>
<td>-107.5</td>
<td>122.1</td>
<td>639.9</td>
</tr>
<tr>
<td></td>
<td>approaching</td>
<td>0.76</td>
<td>-189.6</td>
<td>252.6</td>
<td>4729.1</td>
<td>-92.6</td>
<td>243.2</td>
<td>827.6</td>
</tr>
<tr>
<td>Primary stage</td>
<td>-connection interruption</td>
<td>1.08</td>
<td>226.1</td>
<td>400.7</td>
<td>5421.8</td>
<td>287.8</td>
<td>375.4</td>
<td>344.8</td>
</tr>
<tr>
<td></td>
<td>- utmost height</td>
<td>1.4</td>
<td>325.4</td>
<td>490.2</td>
<td>2089.7</td>
<td>123.8</td>
<td>304.8</td>
<td>1240.1</td>
</tr>
<tr>
<td></td>
<td>- leaving the ball</td>
<td>1.6</td>
<td>24.5</td>
<td>870.1</td>
<td>7542.8</td>
<td>99.7</td>
<td>388.6</td>
<td>970.1</td>
</tr>
<tr>
<td>Final stage</td>
<td>-connection resumption</td>
<td>1.7</td>
<td>98.82</td>
<td>437.4</td>
<td>16.6</td>
<td>-264.5</td>
<td>677.3</td>
<td>655.2</td>
</tr>
</tbody>
</table>

Table 4: Differences between resultant averages of push and force for the body's center of gravity during stages of performing the skills of aiming by high jump and aiming by front jump

<table>
<thead>
<tr>
<th>Stages of performance</th>
<th>Parts of performance</th>
<th>Time</th>
<th>Push</th>
<th>Force</th>
<th>Push</th>
<th>Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary stage</td>
<td>-receiving the ball</td>
<td>0.16</td>
<td>50.4</td>
<td>-60.0</td>
<td>59.1</td>
<td>66.3</td>
</tr>
<tr>
<td></td>
<td>- approaching</td>
<td>0.76</td>
<td>-54.1</td>
<td>145.4</td>
<td>58.6</td>
<td>154.1</td>
</tr>
<tr>
<td>Primary stage</td>
<td>-connection interruption</td>
<td>1.08</td>
<td>85.8</td>
<td>636.9</td>
<td>101.3</td>
<td>599.2</td>
</tr>
<tr>
<td></td>
<td>- utmost height</td>
<td>1.4</td>
<td>752.1</td>
<td>431.5</td>
<td>878.7</td>
<td>442.3</td>
</tr>
<tr>
<td></td>
<td>- leaving the ball</td>
<td>1.6</td>
<td>302.4</td>
<td>420.8</td>
<td>415.5</td>
<td>576.2</td>
</tr>
<tr>
<td>Final stage</td>
<td>-connection resumption</td>
<td>1.7</td>
<td>-466.2</td>
<td>350.4</td>
<td>452.1</td>
<td>404.2</td>
</tr>
</tbody>
</table>

Table 5: Simple correlation coefficients for values of angles and velocities of the aiming hand angles at stages of performance and accuracy of performing the skill of aiming by high jump and front jump

<table>
<thead>
<tr>
<th>Stages of performance</th>
<th>Points and joints</th>
<th>Values of angles</th>
<th>Velocities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Points and joints</td>
<td>Values of angles</td>
<td>Velocities</td>
</tr>
<tr>
<td></td>
<td>of the body</td>
<td>Aiming by high jump</td>
<td>Aiming by front jump</td>
</tr>
<tr>
<td>Preliminary stage</td>
<td>Receiving the ball</td>
<td>Wrist</td>
<td>0.381</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elbow</td>
<td>0.401</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shoulder</td>
<td>0.422</td>
</tr>
<tr>
<td></td>
<td>Approaching</td>
<td>Wrist</td>
<td>0.443</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elbow</td>
<td>0.212</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shoulder</td>
<td>0.471</td>
</tr>
<tr>
<td>Primary stage</td>
<td>Connection</td>
<td>Wrist</td>
<td>-0.501</td>
</tr>
<tr>
<td></td>
<td>interruption</td>
<td>Elbow</td>
<td>-0.523</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shoulder</td>
<td>-0.533</td>
</tr>
<tr>
<td></td>
<td>Utmost height</td>
<td>Wrist</td>
<td>-0.505</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elbow</td>
<td>-0.530</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shoulder</td>
<td>-0.536</td>
</tr>
<tr>
<td></td>
<td>Leaving the ball</td>
<td>Wrist</td>
<td>0.493</td>
</tr>
<tr>
<td></td>
<td>and aiming</td>
<td>Elbow</td>
<td>0.502</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shoulder</td>
<td>0.530</td>
</tr>
<tr>
<td>Final stage</td>
<td>Connection</td>
<td>Wrist</td>
<td>0.498</td>
</tr>
<tr>
<td></td>
<td>resumption</td>
<td>Elbow</td>
<td>0.385</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shoulder</td>
<td>0.301</td>
</tr>
</tbody>
</table>

Significant performance correlation at 0.05 = 0.497, at 0.01 = 0.223
Table 6: Simple and multi correlation coefficient, square of the adjusted correlation coefficient, percentage of contribution and the value of t and f for the variable of velocity angles of the right arm as the most important mechanical variable contributed in the accuracy of performing the skill of aiming by high jump

<table>
<thead>
<tr>
<th>Mechanical variable</th>
<th>Simple-correlation coefficient</th>
<th>Multi-correlation coefficient R</th>
<th>Square of multi-correlation coefficient R²</th>
<th>Percentage of contribution%</th>
<th>Coefficient of partial-regression β</th>
<th>Value of (t)</th>
<th>Value of (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity angles of the right arm</td>
<td>0.7194</td>
<td>0.6881</td>
<td>0.59155</td>
<td>59.55</td>
<td>3.534</td>
<td>2.763</td>
<td>36.0311</td>
</tr>
<tr>
<td>Fixed value = -24.2453</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard deviation = 0.03491</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of (t) at 0.05 = 2.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Simple and multi correlation coefficient, square of the adjusted correlation coefficient, percentage of contribution and the value of t and f for the variable of angle of the ball starting off as the most important mechanical variable contributed in the accuracy of aiming by high jump

<table>
<thead>
<tr>
<th>Mechanical variable</th>
<th>Simple-correlation coefficient</th>
<th>Multi-correlation coefficient R</th>
<th>Square of multi-correlation coefficient R²</th>
<th>Percentage of contribution%</th>
<th>Coefficient of partial-regression β</th>
<th>Value of (t)</th>
<th>Value of (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle of the ball starting off</td>
<td>0.7219</td>
<td>0.5961</td>
<td>0.5843</td>
<td>4.721</td>
<td>2.438</td>
<td>35.0422</td>
<td></td>
</tr>
<tr>
<td>Fixed value = -21.5431</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard deviation = 0.2364</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of (t) at 0.05 = 2.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6 indicates that the velocity variable of the right arm angles is considered the first contributor in the accuracy of aiming by high jump since the percentage of contribution reached 95.55%. The calculated value of (f) (36.0311) was greater than table value of (f) at the significant level 0.01 and the predictable equation of regression for the accuracy value of aiming by high jump with indication of velocity angles of the right arm will be:

\[ S = X + m_1 \times n_1 \]
\[ = \text{fixed value} + (\text{velocity angles of the right arm} \times \text{coefficient of partial regression}) \]
\[ = 24.2453 + (\text{velocity angles of the left arm} \times 3.534) \]

Table 7 indicates that the variable of angle of the ball starting off is considered the first contributor in the accuracy of aiming by front jump since the percentage of contribution reached 58.43%. The calculated value of (f) (35.0422) is greater than the table value of (f) at the significant level 0.01 and the predictable equation of regression for accuracy value of aiming by front jump with indication of angle of the ball starting off will be:

\[ S = X + m_2 \times n_1 \]
\[ = \text{fixed value} + (\text{angle of the ball starting} \times \text{coefficient of partial regression}) \]
\[ = -21.5431 + (\text{angle of the ball starting} \times 4.721) \]

In accordance with what have been reached by the researcher and with the aid of the results of previous studies related to the current research, the researcher will follow the same method of presenting the results according to the following arrangement:
Fig. 2: Averages resultant values for the velocity of the body's center of gravity during stages of performing the skill of aiming by front jump.

Fig. 3: Averages resultant values for the acceleration of the body's center of gravity during stages of performing the skill of aiming by front jump.

Fig. 4: A consecutive dynamic track for the skill of aiming by high jump.

Fig. 5: Average resultant displacement for the skill of aiming by high jump.

Fig. 6: Average resultant velocity for the skill of aiming by front jump.

performing the skill of aiming by front jump since its percentage of contribution reached 58.43% according to the second performance. Therefore, the researcher regarded the importance of the height of the starting point and its influence on both the staring velocity and starting angle for these variables are considered the basic factors determining the path of the ball as a throwing object.

Tables 4-9 concern simple and multi-correlation coefficient, square of adjusted correlation coefficient, percentage of contribution and the value of (F) for the variable of physical abilities most related to the accuracy...
Fig. 7: Average resultant acceleration for the skill of aiming by high jump

of performing the skill of forwarding, indicated that "the force variable distinguished by velocity of the legs (height of vertical jump) is considered a physical ability most contributed in the accuracy of performing the skill of aiming by front jump among the basic study sample since its percentage of contribution reached 64.012%.

The force variable distinguished by velocity of the legs (space of wide jump from stability) is considered the most important physical ability most related to the accuracy of performing the skill of aiming most related to the accuracy of performing the skill of aiming by high jump among the study sample for its percentage of contribution reached 66.0234%. The force variables of the legs (Force of quadriceps) is considered the most important physical ability contributed in the accuracy of performing the skill of aiming by front jump among the basic study sample since its percentage of contribution reached 67.813%.

The researcher mentions that the force distinguished by velocity and utmost force are regarded as the most important basic kinetic abilities determining the accuracy level. A large number of references agreed to the importance of the force distinguished by velocity as the most important physical ability of the handball player especially for the skill of aiming by jump.

CONCLUSION

There is a close relationship between the variables of physical and mechanical variables.

There are differences in the performance of high-skill correction and correction of the front and there are also differences among them in the physical variables for each type of them.

RECOMMENDATIONS

- The need to apply more research in this area to improve skill performance in all games.
- The training program must be applied appropriately for the development of the performance of players based on the results as mechanical variables.
- The need to apply this kind of research on young players, whether collective or individual games.

REFERENCES