SP3005/PH3025 ADVANCED BIOMECHANICS
Laboratory 5
Segment Contribution to Performance

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7. September, 2004

Contents

1 Aims

1. to establish that many body segments make a contribution to performance in activities such as overarm throwing
2. To describe the segmental contributions made by various body segments by quantifying the release velocity of a softball

2 Introduction

For sport science it is very important to know which parts of the body are responsible for a specific action or movement because if this is known. It is possible to analyze the motion of the important body parts and optimize the exercise for the interesting muscles. This will result in an more effective training and better preparation for the athletes.

3 Eqipment

- Video camera
- Grid board
- Softball
- Restraints

4 Procedure

The technique used in this laboratory i one that relies on joint immobilization and subsequent determination in the loss of velocity as a result of not using various body segments.

1. Set up the grid board and camera such that the movement of the ball across the grid line can be tracked
2. Choose a subject.
3. Have the subject throw a softball as far as possible under each of the five conditions listed below. It will be up to the other members of the group to ensure that the subject is constrained appropriately.
   (a) no restraints
   (b) no run up
   (c) restraints at hips and legs

(d) restraints at shoulders, hips and legs

(e) restraints at arm, shoulders, hips and legs.

4. Video tape each throw and determine the vertical and horizontal distance that the ball travelled during the first frame since the ball left the hand. Collect five trials for each condition. Record the data in Table 1.

5. For each throw determine the velocity of the ball as it left the hand. Record this data in Table 1 also.

5 Results and Discussion

- v_0 :
  Restraint: None
  Segment utilised: Run-up, legs, trunk, arms and wrist

x (cm)	y(cm)	$v_x(\frac{m}{s})$	$v_x(\frac{m}{s})$	$v(\frac{m}{s})$
45.00	22.50	11.250	5.625	12.578
37.50	25.00	9.375	6.250	11.267
45.00	22.50	11.250	5.625	12.578

Mean = $12.141 \frac{m}{s}$

- v_1 :
  Restraint: No run-up
  Segment utilised: Legs, trunk, arms and wrist

x (cm)	y(cm)	$v_x(\frac{m}{s})$	$v_x(\frac{m}{s})$	$v(\frac{m}{s})$
40.00	27.50	10.000	6.875	12.135
42.50	27.50	10.625	6.875	12.655
37.50	30.00	9.375	7.500	12.006

Mean = $12.265 \frac{m}{s}$

- v_2 :
  Restraint: Hips and legs
  Segment utilised: Trunk, arms and wrist

x (cm)	y(cm)	$v_x(\frac{m}{s})$	$v_x(\frac{m}{s})$	$v(\frac{m}{s})$
32.50	15.00	8.125	3.750	8.949
27.50	17.50	6.875	4.375	8.149
25.00	15.00	6.250	3.750	7.289
32.50	15.00	8.125	3.750	8.949

Mean = $8.334 \frac{m}{s}$

- v_3 :
  Restraint: Shoulders, hips and legs
  Segment utilised: Arms and wrist

x (cm)	y(cm)	$v_x(\frac{m}{s})$	$v_x(\frac{m}{s})$	$v(\frac{m}{s})$
22.50	12.50	5.625	3.125	6.435
27.50	12.50	6.875	3.125	7.552
22.50	15.00	5.625	3.750	6.760
27.50	15.00	6.875	3.750	7.831
27.50	12.50	6.875	3.125	7.552

Mean = $7.226\frac{m}{s}$

- v_4 :
  Restraint: Arms, shoulders, hips and legs
  Segment utilised: Wrist

x (cm)	y(cm)	$v_x(\frac{m}{s})$	$v_x(\frac{m}{s})$	$v(\frac{m}{s})$
15.00	0.00	3.750	0.000	3.750
7.50	5.00	1.875	1.250	2.253
15.00	2.50	3.750	0.625	3.802
7.50	5.00	1.875	1.250	2.253
15.00	5.00	3.750	1.250	3.953

Mean = $3.202\frac{m}{s}$

$v_x = y * 25s^{-1} \quad v_y = y * 25s^{-1}$

$$v^2 = v_x^2 + v_y^2$$

Can such findings tell the researcher the percentage contribution each segment makes in an unrestrained situation?

If the velocity is measured twice, once with a restraint and once without it is a logical consequence that at least a part of the difference in velocity must be the contribution the restraint segment has add to the situation.

Segmet	Formular	velocity ($\frac{m}{s}$)	Percentage	K.E (J)	Percentage
Run-up	$v_0 - v_1$	0.124	1.0	0.0014	0.04
Legs and hips	$v_1 - v_2$	3.931	32.4	1.4294	35.8
Trunk	$v_2 - V_3$	1.108	9.1	0.1136	2.8
Arm	$v_3 - v_4$	4.024	33.1	1.498	37.5
Wrist	v_4	3.202	26.4	0.9484	23.8

$KE = \frac{1}{2}m * v^2 \quad m = 185g \quad \rightarrow \quad KE = 0.0925Kg * v$

What are the limitations and assumptions made when using the joint immobilization technique to estimate contributions to performance?

The joint immobilization technique assumes that the restrain is made ideal and therefore can not be as accurate as expected. In reality it is complicated to restrain properly and keep sure that the part of body does no longer support the motion.

Also the subject should ideally try to throw the ball with the same effort every time. That is practical not possible because the subject is just a human being. Even if the experiment is repeated more than once the result will be varying.

If you did not have access to a video camera, how else could you determine the speed, v_0, v_1, v_2, v_3 and v_4?

It is possible the measure the ball speed with a radar device or to measure how far the ball is thrown and how long it flew to calculate the speed.

6 Conclusion

In the result it is easy to see that the arm has greatest contribution to the throw (33%). This is not really surprising. That the run-up has only a effect of one percent to the throw was not expected. but for this situation only three values are measured instead of five therefore the result has to be kept with caution. Also the lower part of the body has large influence of the throwing speed (32%).

The results shows that the lower body (legs and hips) the arm and the wrist are equally responsible for the speed of the ball.