BioKinematic Analysis of Tippelt Motion on Parallel Barsin gymnastics

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Abstract

The purpose of this study was to provide an appropriate model for Tippelt movement performance and Tippelt movement training data by quantitative analysis of the kinematic variables of three gymnasts from the Iraqi national gymnastics team. Results of analysis of kinematic differences between the three gymnasts.

1. The joints of the shoulders that extended as far as possible affected the movement of Tippeltin the lower swing. The process of reaching the body mass center to the maximum speed at the point of flection and the body moves from the vertical phase to the forward direction, making movement control as possible.
2. The high swing movement made the air stable and made the control of the body quickly move to the anterior direction by extending the shoulder and hip joints to reverse the direction.
3. That fly up and erect the body quickly and ease the angle of the hip joint on the high flight. When the motion was performed with an inverse rotation force making the movement stable.

As a result of this study, it appears that sudden drop and maximum shoulder joint extended is important when performing Tippelt motion in parallel bars. The maximum hip flexion at the starting point of the ascending swing, the sudden extended to the opposite direction of the shoulder and hip joints when leaving the parallel bars, the control of the body moving to the forward direction, and the reduction of the angle of the hip joint in the flight phase is important.

1- Introduction

Performance on a parallel barsapparatus consists mostly of swing and flight elements defined from all component groups available in the Men's Code of point [1]. It is performed in continuous transition through different positions. Such as hang, support, and many swing elements that lead to or start from handstand position on one or two bars. Tippelt in parallel bars is only a valuable element D difficulty value, yet is considered an element in the technical preparation process.

The research of biomechanics in artistic gymnastics has been greatly developed over the years [3]. However, the lion's share of research focused on vaults [4] and takeoff and landing on floor exercises [5]. dismounts and flight elements and mechanics of giant swings on high bar and uneven bars [6]. Research on parallel bars is usually limited [7]. Interestingly, although the tippelt performs on parallel bars are considered the basic skills for further technical development, there is scarcity of scientific data on skill including case study.
The proper implementation of the movement of the body leads to a successful athlete performance. Biomechanics is the "study of the structure and function of biological systems by mechanical methods" [8].Factor instead of the physical structure or physiological capacity [9].Because biomechanics are essentially the science of motion technique [10].Trainers and teachers in physical education they want their players to extract the maximum achievements of the training without causing a lot of strain on them [11].It may be necessary to develop programs of study for technical training in bio-mechanics, sports, and technicians who can provide services purchased by sports bodies type [12].
the Training in gymnastics is currently close to its biophysical limits and with the development of the code of points [13].And the desire to constantly pursue complex moments and innovation. In gymnastics, each skill has a mechanic direction. In this context, mechanical principles such as motion, velocity, center of mass, takeoff angle, landing and impulse angle play an important role in performance. The ultimate goal of the biomechanics training interface in gymnastics training is to make training more effective, efficient and safe.
The present study hereby makes an effort to broaden the horizon of knowledge by bringing new facts and thoughts by exploring the relationship of selected kinematic variables with the performance Moy on parallel bars in men's artistic gymnastics. Therefore, the importance of research lies in the provision of technical training materials.

2- Methodology

2-1 Subjects

Three gymnasts from the Iraqi national gymnastics team.These gymnasts were selected based on their level of proficiency in tippelt and they have a level in gymnastics competitions. all subjects were purposely selected, who had a good command in the particular skill (tippelt) on Parallel Bars, were selectedFigure (1) as the subject for the present study and there the characteristics of the Subjects are shown in Table 1.

Table 1. Characteristics of the gymnasts

Subjects	Age(year)	Height (cm)	Weight (kg)	Training experience (years)
S1	20	167	**62**	**14**
S2	19	**171**	**59**	**15**
S3	20	**165**	**62**	**15**
M±SD	**19.67±0.58**	**167.66±3.06**	**61±1.73**	**14.68±0.58**

S=Subject, M= mean, SD= standard deviation

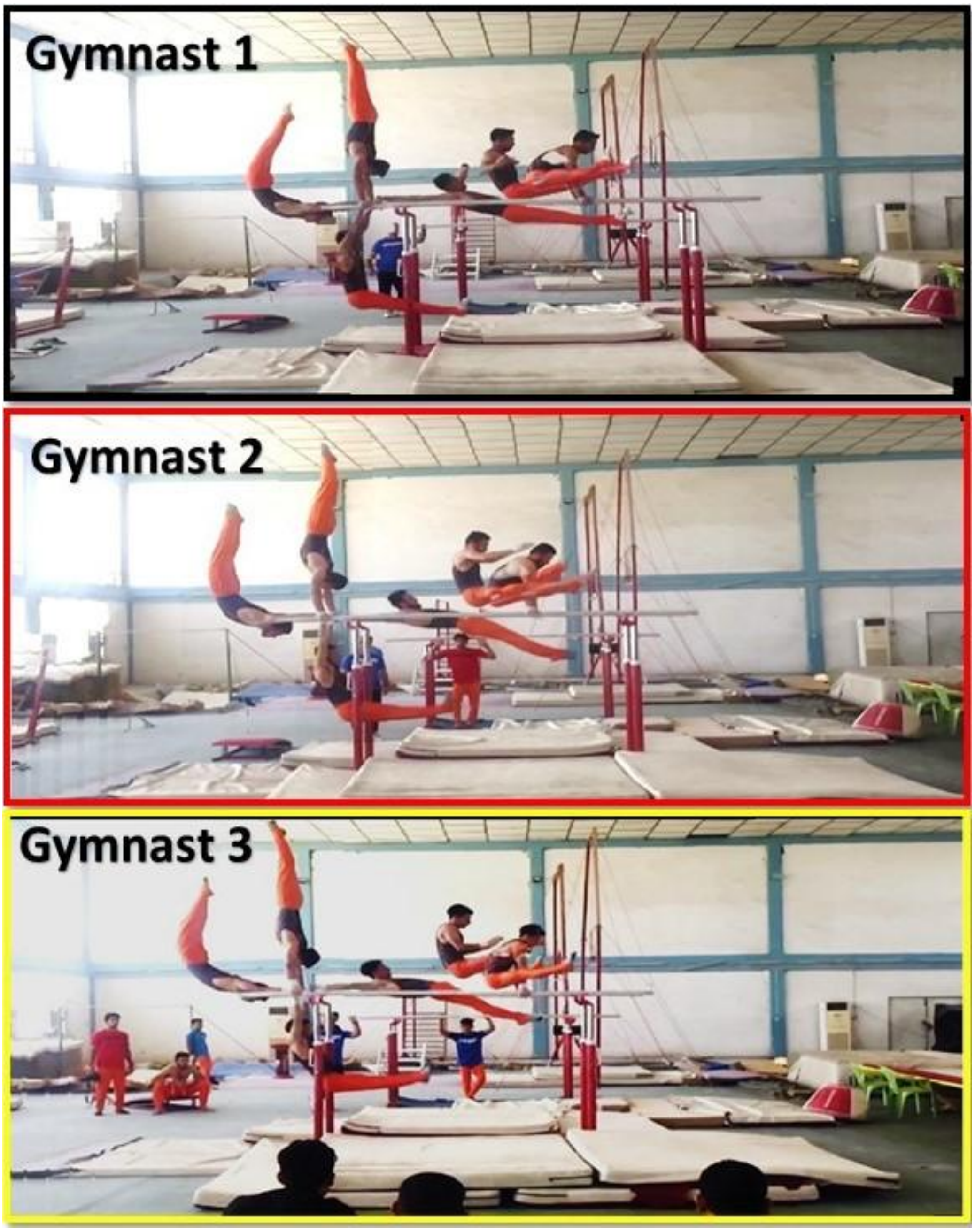

Figure 1: Subjectsphotographic sequence

2-2 Analysis contents and experimental procedure

Analyzes are body - centered time, position change, velocity change, shoulder angle joint, hip angle joint, angle of rotation.

Videographywasemployedforthekinematicsanalysisoftipplet to support on Parallel Bars.Thecamerathatwasusedforthisstudywasastandard SonyHDR-PJ10.Thefrequencyofthecamerawas60frames/secondwithHDqualityofvideo and the camera was operated about one second before the start of this operation so as to keep the camera speed constant.Thevideocamerawasmountedonthetripodstandattheverticalheightof1.50met ersofcapturingactiononparallelbarsthevideocamerawasplacedperpendicularlyatcenteri

nthelineofthesubjectsto thesagittalplaneatadistanceof7
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2.3 Definitions of events, phases

Events, stages and definitions identified in this study
(Figure 2) (Figure 3) and the like.

1) The event:

1) The first event: The point at which the player's body starts to swing down and the body is extended to the maximum.
2) Second event: bend the hip joint to the maximum in the lower swing.
3) The third event: when the hands are thrown from the parallel bars during the height of the upward swing.
4) Fourth Event: The point at which the object is raised by flight to the maximum height above the parallel bars.
5) Fifth Event: support the two hands on the parallel after the height of the swing.

2) Phases

1)Phase (1) (downward swing Phase): Phase of the point where the body extended to the maximum where the hip flection to the maximum extent by the start of swing downward to support position on the hands.

2)Phase 2 (swing height in descending swing): Phase where the hip is flexed to the point where both hands are separated from the parallel bars.

(3) Phase 3 (ascending flight phase): The phase in which the hands are separated from the parallel bars in the ascending phase when the body when in maximum height in the air.

(4) Phase 4 (flight phase in air): From the point where the player's body flies in the air to the point of support on the parallel beam.

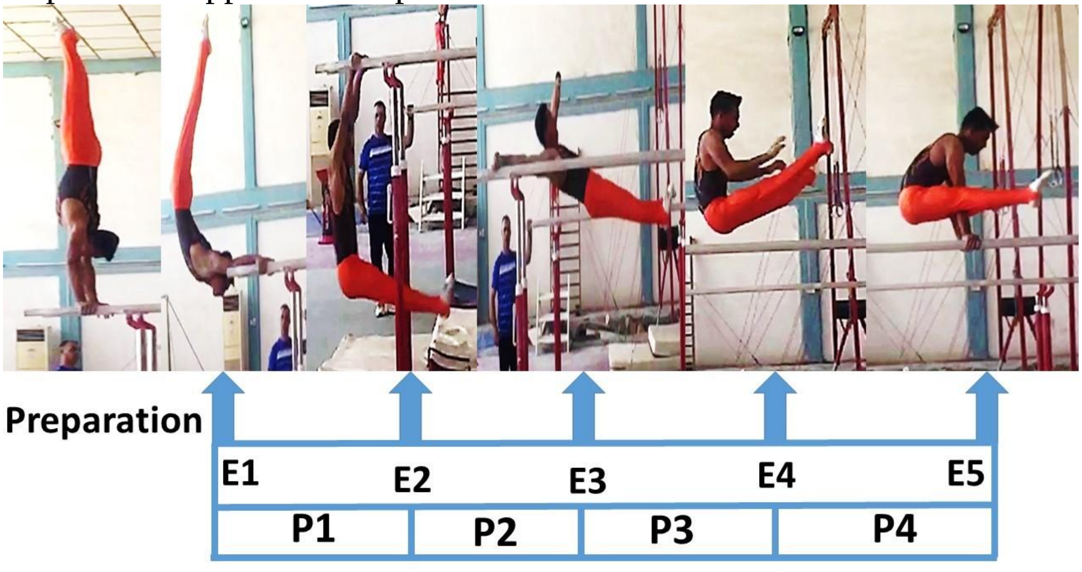

Figure 2. Events and phases of tippelt action

3) Angles definitions

(1)Shoulder angle (θ1): Relative angle between the humerus and body.

(2)Hip angle (θ2): relative angle between the femur and the body.

(3)The body rotation angle (θ3): Absolute angle of the body forming the X –axis.

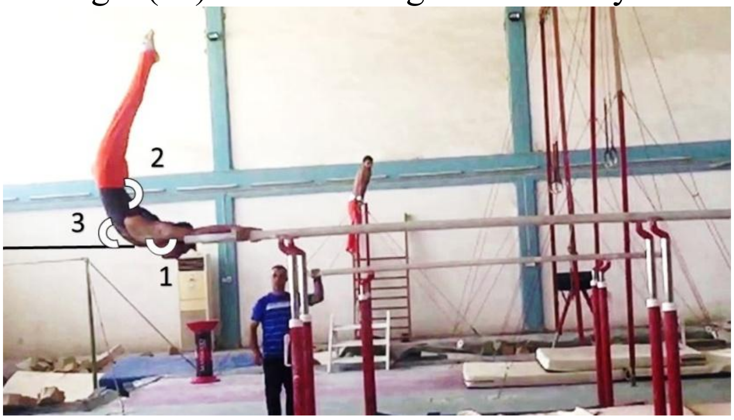

Figure 3. Angles definitions

2-3 Data processing

Videography technique was employed in order to register the performance of the subjects in tipplet on parallel bars in the study. Selected kinematics variables (table 1, table 2, table 3, table 4) and five selected phases of whole skill were analysed. The selected stages were taken out from the video by using the latest version of kinovea software (08.25) was used for digitizing in the data and converting the raw data into numeric values. The subjects performed the skill with full of control and with proper technique. One best trail was taken into consideration. The center of mass was located also by using (kinovea software)From the photographic sequence, the stick figuresof the selected movements were located by Dartfish software.

3- Results and Discussion

1) Time

Table (2) Time required by each phase per second.

gymnasts	Phases				total
	P1	P2	P3	P4	
1	0.43	0.26	0.29	0.10	1.07
2	0.45	0.27	0.38	0.11	1.21
3	0.53	0.30	0.31	0.18	1.32
M	0.47	0.28	0.33	0.13	1.21
SD	0.05	0.02	0.05	0.04	0.16

Table 2 shows the time required for gymnasts performancetippelt skill in parallel bars. As shown in Table 2, the mean time in the first phase was 0.47 and with a standard deviation of 0.05 seconds. In the second phase the mean was 0.28, the standard deviation was 0.02 seconds, the mean in the third phase was 0.33, the standard deviation was 0.5 seconds, the mean in the fourth phase was 0.13 and the standard deviation 0.05 seconds.

The time required between the gymnasts was the shortest time in the first gymnast 1.07 seconds and the third gymnasts is the longest time 1.32 seconds. In the first stage the first gymnasts 0.43 seconds and the second gymnasts, 0.45 seconds and the third player for 0.53 seconds. This can be considered as a long period due to the corners of the joints of the shoulder and hip that cannot be extended sufficiently in the descending swing, and accelerate the shift to the movement of bending. In the second phase, the third gymnast was the longest in 0.30 seconds, increasing the body to be high and lifting the gymnast's body to make the transition to the next phase, the third phase, more stable and more efficient. On the other hand, the first gymnast has a short time in the rising phase in 0.26 seconds. This means that the gymnast has not raised enough of his body and thus increases the gymnast's body in the flight of the Y axis, which has factors that hinder the process of skill tippelt effectively. In the third phase the second gymnast has the longest time of 0.38 seconds, which means long flight time in the air. However, the long period in the gymnast is longer in height and stability in the second phase. In the fourth phase, the third gymnast was the longest at 0.18 seconds, hinting the need to rise in the fourth event was higher.

2) Horizontal and vertical displacement.

Table (3) Horizontal and vertical displacement in each event (cm)

		events				
gymnasts	axis	E1	E2	E3	E4	E5
1	X	49.25	49.76	49.25	54.77	57.75
	Y	8.61	93.94	184.57	207.49	224.34
2	X	49.33	48.31	50.61	57.80	57.36
	Y	8.45	95.90	185.41	208.84	218.62
3	X	48.83	48.41	49.68	55.77	55.17
	Y	16.76	88.58	186.01	250.06	280.23
M	X	49.14	48.82	49.85	56.11	56.76
	Y	11.27	92.81	185.33	222.13	241.06
SD	X	0.27	0.81	0.69	1.54	1.39
	Y	4.75	3.79	0.72	024.20	34.03

The arithmetic mean of the first event was 49.14 and the standard deviation was 0.27 cm at the maximum stretch of the body. The mean of the second event was 48.82 and a standard deviation of 0.81 cm at the maximum flexion of the body. The arithmetic mean of the third event was 49.85 cm and a standard deviation of 0.69 at the point where both hands were separated from the parallel bars. The arithmetic mean of the fourth event was 56.11 cm and a standard deviation of 1.54 at a time when the body is raised body at the highest height on the parallel displays. The mean arithmetic average of the fifth event was 56.76 cm and the standard deviation was 1.39 at the hand support point.

The second gymnast in the first event was his horizontal displacement X 49.33 cm and then the first and third respectively, the gymnast was 49.76 cm highest in the second event and then the third and second respectively. In the third event, the second gymnast was the top 50.61 cm and the first and third respectively and was the second highest gymnast at 57.80 cm in the fourth event during the movement and is considered the most swing left and right is the third largest player in the fifth event 56.76 cm.

The arithmetic average at the time of the body stretched to the maximum extent 11.27 cm. The arithmetic average of the position body in the vertical direction of the event and the second 92.81 standard deviation 3.79 cm at the time of the joints of the body bend to the maximum. The arithmetic mean of the body position in the vertical direction of the third event was 185.33 cm and a standard deviation of 0.72 cm while both hands were separated from parallel bars.The arithmetic mean of the body position in the vertical direction of the fourth event was 222.13 cm and the standard deviation was 24.20 cm at the highest elevation on the parallel displays. The arithmetic mean of the body position in the vertical direction of the fifth event was 241.06 cm and the standard deviation was 34.04 cm when the hands support.The first event in the third gymnast is more forward with 16.76 cm, which means that there is not enough release from the next step to the second event in the swing down and moving quickly to the maximum flex. In the second event, the first gymnast was moving further at 95.90 cm, which is considered to facilitate the transition from the gymnast 's body to flight to the upper bound movement which is release hands from the parallel bars. On the other hand, the third gymnast is less moving at 88.58 cm which is one of the factors focusing on The flight body of the gymnast is flexed and the movement rising to forward. In the third event, the third gymnast made the sharpest difference. 184.57 cm and the third gymnast moved further in 186.01 cm. In the fourth event he was the first gymnast in 207.49 cm and the second gymnast in 208.84 cm and the third gymnast is similar at 250.06 cm. In the fifth event, the third gymnast made a sharp difference of 280.23 cm, which appears to be in the upward movement due to insufficient release in the first event, and the rapid timing from the starting point to turn the gymnast 's body into the rising swing in the second event.

3) vertical and horizontal velocity

Table (4) vertical and horizontal velocity of the center of mass of the body in each event unit (m / s).

		Events				
gymnasts	**axis**	**E1**	**E2**	**E3**	**E4**	**E5**
1	**X**	**-0.11**	**-0.06**	**0.12**	**0.14**	**0.02**
	Y	**-0.86**	**4.64**	**1.27**	**1.74**	**0.81**
2	**X**	**0.02**	**0.04**	**0.15**	**0.14**	**0.01**
	Y	**-1.43**	**5.08**	**2.52**	**0.63**	**1.21**
3	**X**	**-0.04**	**-0.01**	**0.1**	**0.08**	**0.06**
	Y	**-1.27**	**4.62**	**1.25**	**1.24**	**1.67**
M	**X**	**-0.04**	**-0.01**	**0.12**	**0.12**	**0.03**
	Y	**-1.19**	**4.78**	**1.68**	**1.2**	**1.23**
SD	**X**	**0.05**	**0.05**	**0.03**	**0.03**	**0.03**
	Y	**0.29**	**0.26**	**0.72**	**0.55**	**0.43**

Arithmetic mean The horizontal velocity according to the first event is -0.04 m / s and with a standard deviation of 0.05 at maximum stretch of the body. and the arithmetic mean of the horizontal velocity according to the second event is -0.01 m

/ s and with a standard deviation 0.07, while the hip joint is maximally flexion and Arithmetic mean of the horizontal velocity according to the third event is 0.12 m / s with a standard deviation of 0.03 and the arithmetic mean of the horizontal velocity according to the fourth event is 0.12 m / s with a standard deviation of 0.03 and the arithmetic mean of horizontal velocity according to the fifth event is 0.03 m / s and with a standard deviation of 0.03.

In the fourth event the gymnast's body is in flight condition to the highest level on the two parallel bars. It showed the same velocity and stability at the point of departure from the parallel bars, and showed the slowest response at the maximum bend point of release from the two parallel bars. The velocity of movement at the top and bottom showed the second player a quick velocity at the maximum time of flexion, and a quick operation in the maximum stretch of the third gymnast, but it showed time slow to get to the point of departure.

4) Angles of shoulder, hip and axial angle

Table (5) Angles of shoulder, hip and axial angle in each event. Unit (degree)

		Events				
gymnasts	angles	E1	E2	E3	E4	E5
1	shoulder	123.56	123.07	110.43	57.53	52.88
	hip	228.34	102.76	146.97	47.36	37.35
	axial	167.68	283.08	335.60	258.73	234.66
2	shoulder	124.07	121.42	112.44	54.18	58.33
	hip	218.49	128.16	175.61	39.06	45.21
	axial	137.73	284.55	327.40	256.45	256.11
3	shoulder	121.80	126.37	116.05	57.62	53.45
	hip	232.52	116.36	170.26	43.83	39.78
	axial	152.52	281.54	334.27	261.20	249.12
M	shoulder	123.14	123.62	112.97	56.44	54.88
	hip	226.45	115.76	164.28	43.41	40.78
	axial	152.64	283.05	332.42	258.79	246.63
SD	shoulder	1.19	2.52	2.85	1.96	3.00
	hip	7.21	12.71	15.23	4.17	4.02
	axial	14.97	1.51	4.40	2.38	10.94

Table 5 shows changes in the angle of the shoulder, hip angle, and angle of rotation of the body (axial angle) for each tippelt movement.

1) Shoulder angle.

In the second event he was the biggest gymnast at 126.37degree. In the third event, the first gymnast smaller degree was at 110.43, and the third was the biggest gymnast at 116.05 degree. This causes the flight's body on the rise, seems to be closely associated with the movement. In the fourth and fifth events, the second gymnast was 54.18 and 58.33, respectively, indicating that the player's body was flying high to enable stability in the air. The first gymnast shows a large angle at peak time to the maximum bending, and change the angle similar after the deviation point.

2) Hip angle

Respectively. In the first event, the third player was the largest at 232.52 degrees, and in the second event, the first player was the smallest at 102.76 degrees. This is the factor that leads to fast and large work when it comes to the point of indentation in parallel bars, and the second gymnast is the largest at 175.61 degrees in the third event, because it is not enough to flex the lower body. In the fourth event, the second gymnast was the smallest at 39.06 degree, suggesting that the lower body was effective for lifting the body. In the fifth event the second gymnast is 45.21 degree, which is associated with the forward movement of the body flying during the upward movement. the second gymnast showed the smallest angle in the hip from first to the maximum flexion, and the third player showed the largest angle of the joint during the operation.

3) rotation angle

Respectively. In the first event, the third gymnast was small at 152.52 and the first player was the largest at 165.37. This seems to be due to the soft circular motion of the third gymnast in the swing down, while the gymnast produced a rapid descent from the flight of his body, slowing the time to maximum flexion to control the sudden forward movement. The third gymnast in the third, fourth and fifth events was higher at 281.54 degree, 334.27 degree, and 261.20 degree, respectively, Because the body was moved forward because of the maximum point of bending and the body was not stopped at the highest height, the first, second and third event showed similar rotation angles in the flight of his body.

4- Conclusion and Recommendations

4- 4 Conclusion

1. In the first stage, the maximum extension of the shoulder joint has been shown to affect the entire movement of the tippelt through the swing down to accelerate the center of mass to the maximum flexion of the hip joint and the body moves forward from the vertical level and possible control of movement.
2. During the rise in the second swing, the gymnast's body was able to secure flight stability by controlling suddenmovement to forward and expanding the shoulder joint and hip joint in the opposite direction at a rapid pace.
3. At the height of the third stage, it is necessary to lift the body quickly flight, and show that reducing the angle of the hip affects the height of the body, and the implementation of a stable operation at the reverse strong rotation.
4. The results of this study are as follows. First, the shoulder flexion is extended to the maximum in the performance of the tippelit process on the parallel bars, the maximum in the hip flexion at the beginning of the upward shift, rapid expansion in the opposite direction of the shoulder joint and hip joint, limit the hip angle in the flight stage.

4-5 Recommendations

1) extending the joints of the shoulder in the first phase to maximize the acceleration of the center of the weight of the body lower swing.
2) Reduce the flexion of the hip in the second stage to get enough flight when the hands leave parallel bars.
3) Increase the velocity in the third phase to obtain stable motion during flight over the parallel bars.
4) exclusion the center of mass of in the first stage and rounded in the second phase and its exclusion it in the third from through the control of the angle of the shoulder and hip and accelerate the movement.

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