Analysis case of Performance during front handspring front tuck on gymnasts in floor exercise

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ABSTRACT

The purpose of this study is to compare and analyze time of elapsed phase-by-phase, center-mass, changes in angles joints and, angular velocities at each phase of Front handspring front tuck performed by four gymnasts from the Iraqi National Gymnastics Team. In addition to provide quantitative data highlighting the strengths and weaknesses of gymnasts to enable a more stable landing technique.The results show that, for the performance of front handspring front tuck, a lot of time; it was enough to turn the player's movement in the air,shortening the time required until the hands are released.A short horizontal displacement was shown by folding the body to obtain a sufficient amount of turn to the maximum height vertical displacement continuously increased to the front air flight to increase the sufficient amount of rotation.The hips are flexed until the hand stitches, while the handspring are extended to the maximum extent until the jump. In order to obtain a sufficient amount of rotation after taking off from the ground.the shoulder angular velocity was fast during the hops step, and the slow angular velocity of the shoulder until the take-off after the hand spring.

Keyword: gymnasts, kinematic, shoulder, hip, velocity.

. Introduction

The increasing nature of the more complex elements of gymnastics is constantly increasing, making it difficult for the experts to see and monitor them, and to obstruction the correction of errors in the performance of certain movements and non-standard executions. Dynamic mechanical research provides us with concrete and quantitative information, based on the specific criteria that can be determined. The potential of detecting errors on the basis of quantitative information is much more accurate than that based on perception, which ensures a faster way to optimize the implementation of specific gymnastics elements [1, 2].

In gymnastics, the front hand is considered to be one of the main elements of acrobatics, through which other contacts are made with other acrobatic elements, with a rotation around the front axis of the body [3, 4, 5].

This element is an integral part of the series in an acrobatic series. This can be done from different initial positions where the main objective is to convert the linear motion of the body to the rotation, with a minimum horizontal

velocity loss. Also, it is necessary to create basic prerequisites for pushing off and the successful implementation phases of flight [4, 5].
The Training in gymnastics is currently close to its biophysical limits and with the development of the code of points 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 [6].
The importance of the research to contribute to the identification of the technical characteristics of the performance of the movement of the skill of the front handspring front somersault tuck and the characteristics of the linking phase between them,With clarifying changes in the mechanical aspects and technically to the skills of the study at the link between them,
As important backs mechanical aspects of aspects of the study is the skills of great importance in the process of education and develop the skill of the study, whichis reflected positively on the level of performance of the kinetic chain on the floor exercise

Methodology

Subjects

Four gymnasts 3 from the Iraqi national gymnastics team and one fromMaysanat Gymnastics hall in Baghdad, during Iraqi clubs competitionsThese gymnasts were selected based on their level of proficiency in front handspring front tuck and they have a level in gymnastics competitions. all subjects were purposely selected, who had a good command in the particular skill front handspring front tuck on floor exercise, 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

Gymnasts	Age(year)	Height (cm)	Weight (kg)	Training experience (years)
G1	20	167	62	14
G2	19	171	59	15
G4	20	165	62	15
G5	15	142	41	11
M±SD	2.38**±**18.50	13.07**±7**161.25	10.10 **±**56	1.89**±**13.75

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

Experimental procedure

Analyzes are time of elapsed phase-by-phase, Horizontal and vertical displacement for center of mass, changes in angles joints and, angular velocities at each phase of Front handspring front tuck.

Videographywasemployedforthekinematicsanalysisoffront handspring front tuck on floor exercise .ThecamerathatwasusedforthisstudywasastandardSonyHDR-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.Thevideocamerawasmountedonthetripodstandattheverticalheightof 1.50meters ofcapturingactiononfront handspring front tuck thevideocamerawasplacedperpendicularlyatcenterinthelineofthesubjectsto thesagittalplaneatadistanceof10 meterscapturingactiononfront handspring front tuck.

Define events, phases, and angles of motion

The events and phases of the operation are show in (Figure 1).

1) Event Set

1) Event: the moment the front foot touches the ground.
2) Event: When the hand touches the floor.
3) Event: When the hand is release after handstand.
4) event: moment when the leg comes off the ground after handspring
5) Event: Body-centered highest peak moment.
6) Event: landing moment.

2) Phase set

Phase 1: From the moment, the forefoot reaches the ground to the moment when both hands touch the ground.

Phase 2: From the moment when both hands reach the ground to the moment when the hands are release after the wheel.

Phase 3: From the moment when both hands are release to the moment when the legs take off from the ground after handspring.

Phase 4: from the moment when the legs take off from the ground to the highest height in the center of the body

Phase 5: From the height of the body center to the moment of landing.

3) Definition of angle

· Shoulder angle: relative angle between upper arm and body.

· Hip angle: relative angle between the femur and the body.

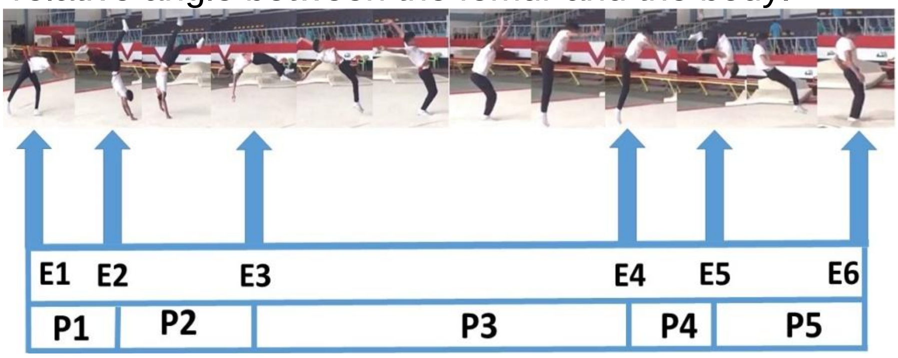


Figure 1. Events and phases of front handspring front tuck action

Data processing

Videography technique was employed in order to register the performance of the subjects on front handspring front tuck in the study. Selected kinematics variables (table 1, table 2, table 3, table 4) and five selected phases and 6 events of whole skill were analysed. The selected phaseswere 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). Statistical Processingwas done with Minitab 17.

Results and Discussion

1. Time required by each phase.

Table (2) show the time spent for body movements in front handspring front tuck.(Unit: sec).

Gymnasts	Phases					total
	P1	P2	P3	P4	P5	
G1	.11	.15	.45	.33	.47	1.51
G2	.19	.23	.39	.34	.41	1.56
G3	.13	.21	.40	.35	.37	1.46
G4	.14	.17	.43	.33	.39	1.46
M	0.14	0.19	0.42	0.34	0.41	1.50
SD	0.03	0.04	0.03	0.01	0.04	0.05

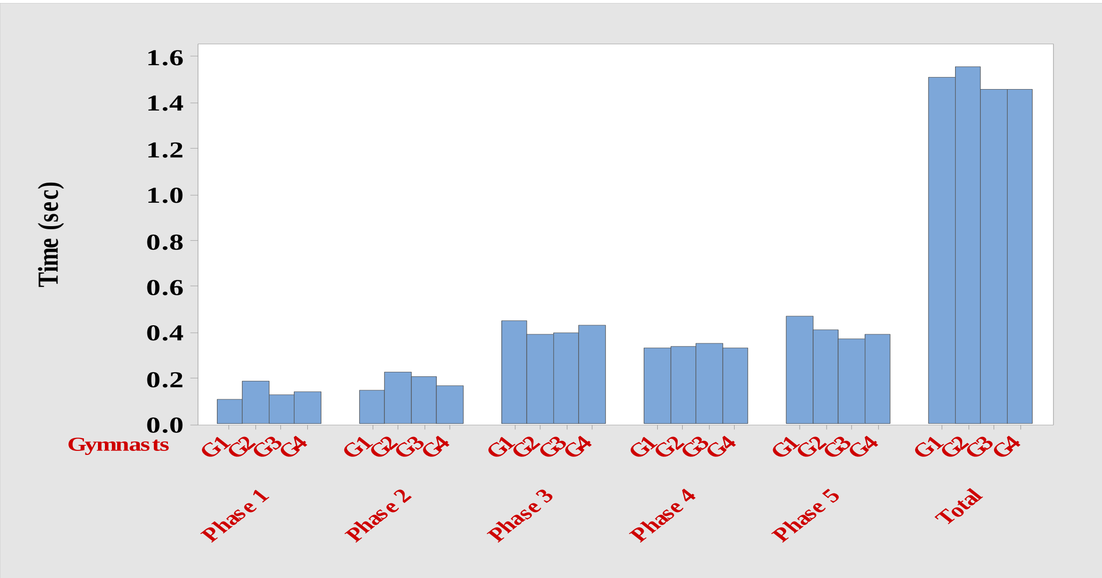


Figure 2. The period spent by phases

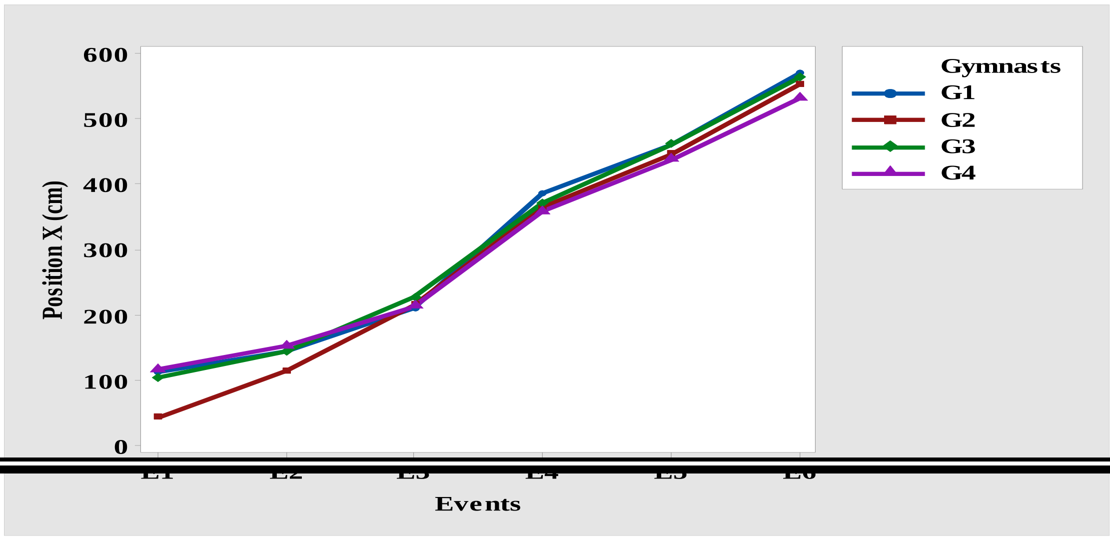
The mean time spent for the operation front handspring front tuck body were (0.14 sec) for first Phase (0.19 sec), second Phase (0.42 sec), third Phase (0.34 sec), fourth Phase, (0.41 sec) and fifth Phase. Average timeof from first phase tothird phase infront handspring was (0.75 sec) and fromfourth phase tofifth phase was (0.75 sec) infront tuck and the total time required was (1.50sec). That is, the first phase and the second phase have the shortest time, whereas the third phaseit was longer and which is the public phase of the handspring,Front tuck in air operation from the fourth phase to the fifth phase showed air operation a similar amount of time. In this way, it is seen that the hand stepping and the stepping motion are hopped step by step to keep on linear speed and to make enough rotation motion. This means that the handshake flight time of the three phases is lengthened, and the forward flight of the four phases represents the shortest time by tuck the body to obtain a sufficient amount of rotation. By tuck and stretching the body in order to perform the operation, it showed a longer time than other subjects did. As a result of the kinematic analysis of the front handsprings according to Bae Nam et al [7].it took a short period from the hop to the moment when the hands were tied and legged. This was because the legs were vertically bent the results of this study suggest that hand and foot movements are important factors in the handspring. On the other hand, Oh-Seok Kwon and Yang-JinYoon[8].comparedbetween Handspring Salto Forward Tucked and Handspring Salto Forward Stretched of the handspring body flexion to 1.45sec and 1.42sec respectively. The results showed that there was a significant difference in the time taken between the hand springs, the body protruding in front of the body, and the air protrusion in front of the body.

Taken together, it is possible to achieve a hand wheel motion with sufficient rotational motion by shortening the time required until the hands are released and the hands are released from the hop step. In addition, it is necessary to quickly fold the body after leaving the ground in the 4th phase to secure a sufficient amount of rotation, and it is important to lengthen the time required by spreading the folded body in order to prepare for landing safely.This is consistent with Nelson N, G, Mitos. The degree of palm constriction increases as the tendency to push up is high, both desirable, and there is correlation with high degrees performance by shortening the contact time for hand [10].

2. Changes in body center

1) Horizontal change of the body center

Table (3) show the horizontal changes of the body center during the operation of body movement in front handspring



front tuck (Unit: cm)

Gymnasts	Events								
	E1	E2	ΔE1E2	E3	E4	ΔE3E4	E5	E6	ΔE5E6
G1	112.7	144.5	31.8	210.4	386.5	176.1	462	569.3	107.3
G2	43.6	114.7	71.1	216.2	365.3	149.1	446.7	552.7	106
G3	104.5	145	40.5	227.4	371.5	144.1	461.2	563.6	102.4
G4	116.7	153.3	36.6	213.6	358.4	144.8	438.3	531.4	93.1
M	94.40	139.38	45	216.90	370.43	153.5	452.05	554.25	102.2
SD	34.23	16.94	17.8	7.39	11.98	15.21	11.55	16.72	6.41

Figure
(3): Horizontal change of body center

Table 3: shows the average horizontal changes of the body center during the operation of the handwheel body folds were (94.40cm) in E1, (139.38cm) in E2, (216.90cm) in E3, (370.43cm) in E4, (452.05cm) at E5, (554.25cm) at E6. As shown in Fig. 4, the horizontal movement variation tends to increase continuously from the hop step to landing. In this way, the hand movements of the handspring are fully extended during the hand movement until the legs are released from the ground. And it was separated from the ground The body was folded up to the air flight, and the vertical rise showed a short horizontal displacement. However, in the 5th phase, the horizontal movement displacement was increased by extending the flexion joint to perform safe landing motion during the rear air flight. According to Oh-Seok Kwon and Yang-Jin Yoon [8].There is a statistical difference in E5 between the motion of the hand protruding body and the protrusion of the body in front of the body, and 469.15cm and 499cm, respectively. In order to obtain a sufficient amount of rotation from the ground to the front airborne, the horizontal displacement was increased by leaning forward. The result of this study was 450.7cm in average, Horizontal displacement. From the results of this study, it was found that the long horizontal displacement was achieved by fully extending the body during the short horizontal displacement from the

hop step to the hand grip and the hand spring motion, A short horizontal displacement was shown by folding the body to obtain a sufficient amount of turn to the maximum height, and a long horizontal displacement was obtained by extending the flexed body to perform a safe landing motion.

2) Vertical change of body center

Table (4): shown vertical changes of the body center during the operation of the air spring in front of the handspring (Unit: cm)

Gymnasts	Events								
	E1	E2	ΔE1E2	E3	E4	ΔE3E4	E5	E6	ΔE5E6
G1	72.4	78.7	6.3	81.4	93.1	11.7	159.2	102.5	56.7-
G2	71	76.6	5.6	85.6	92.7	7.1	142.3	91.2	51.1-
G3	75.2	78.7	3.5	88	94.9	6.9	147.2	98.4	48.8-
G4	69.1	79.5	10.4	82.5	97.6	15.1	154.5	101.3	53.2-
M	71.93	78.38	6.45	84.38	94.58	10.2	150.80	98.35	52.45-
SD	2.57	1.24	2.9	3.00	2.23	3.95	7.52	5.07	3.36

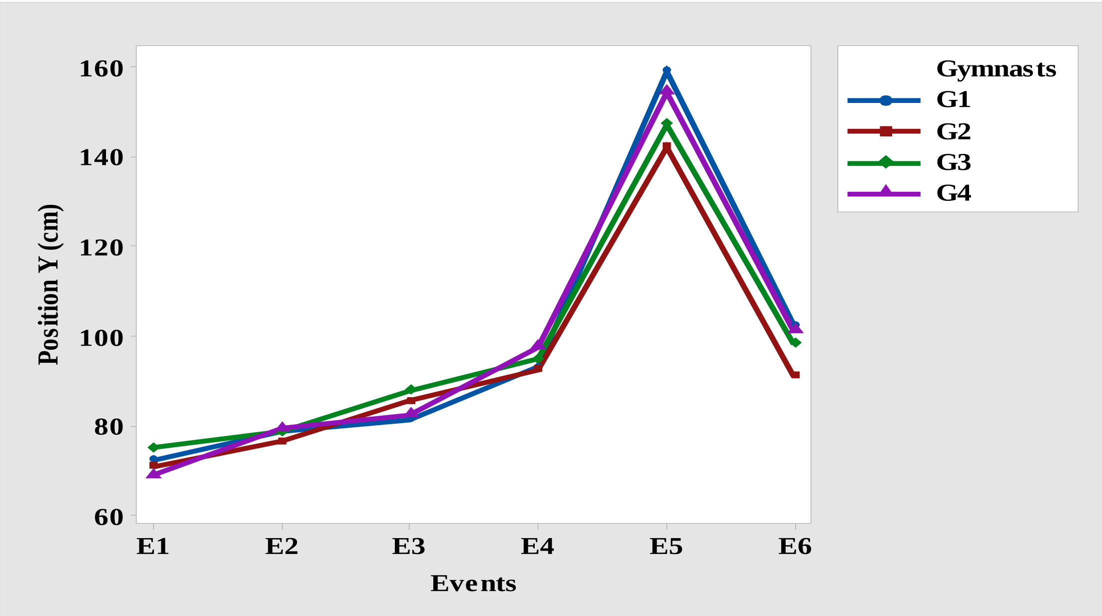


Figure 5. Vertical change of body center

As shown in (Table 4), the average vertical changes of the body center during the operation of the hand protuberance were (84.38cm) in E1, (71.93cm) in E2, (78.38cm) in E3, (94.58cm), (150.80cm) in E5 and (98.35cm) in E6, respectively,

As shown in (Fig. 5), the vertical displacement is decreased by hoisting the trunk in the hopping step. When the leg is separated from the ground, the whole body moves in a vertical posture, And the vertical displacement continuously increased to the front air flight to increase the sufficient amount of rotation. On the other hand, the vertical displacement decreased again in the rear air flight past the body center peak.

In the study of Oh-Seok Kwon and Yang-Jin Yoon [8].153.1cm and 98.7cm in E5 and E6, respectively, and 140.3cm and 91.1cm in E5 and E6, respectively, the results of this study show that the air flaps in front of the body folds are flying at a higher position, but they are very similar to each other. In order to obtain a sufficient amount of rotation, the vertical position of the upper body was lowered in order to obtain a sufficient amount of rotation, while the rotation radius was smaller. However, the operation of the air bending front body and the front- It can be seen that the aerial motion is performed at a higher position by vertically erecting the upper body.
In summary, the vertical position of the high body center when leaving the ground is closely related to the height of the body and the time of the body, and the insufficient height is a factor of the deduction, it should be pushing.

3. The body Joint angle

1) Shoulder angle

Table (5): the angle of the shoulder joint of the front handspring front tuck(Unit: degree)

Gymnasts	Events					
	E1	E2	E3	E4	E5	E6
G1	152.2	151.7	135.2	107.8	44.8	105.8
G2	112.3	158.6	152.3	124.6	43.2	78.7
G3	139.3	159.4	127.1	89.5	37.6	46.3
G4	123.1	146.3	126.5	132.3	33.2	39.6
M	131.73	154	135.28	113.55	39.70	67.60
SD	17.59	6.19	12.02	19.02	5.32	30.66

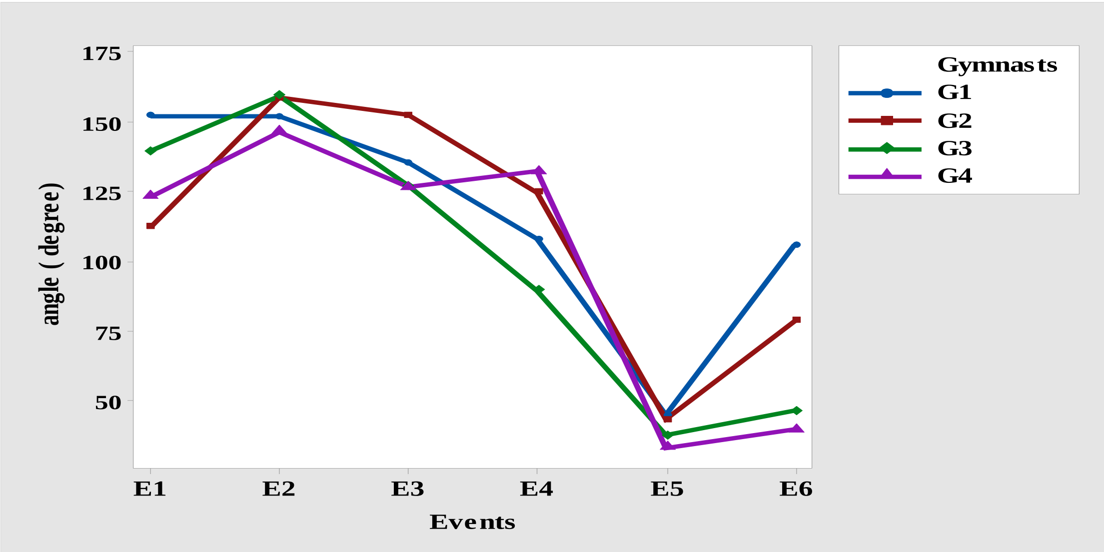


Figure (6). Shoulder angle

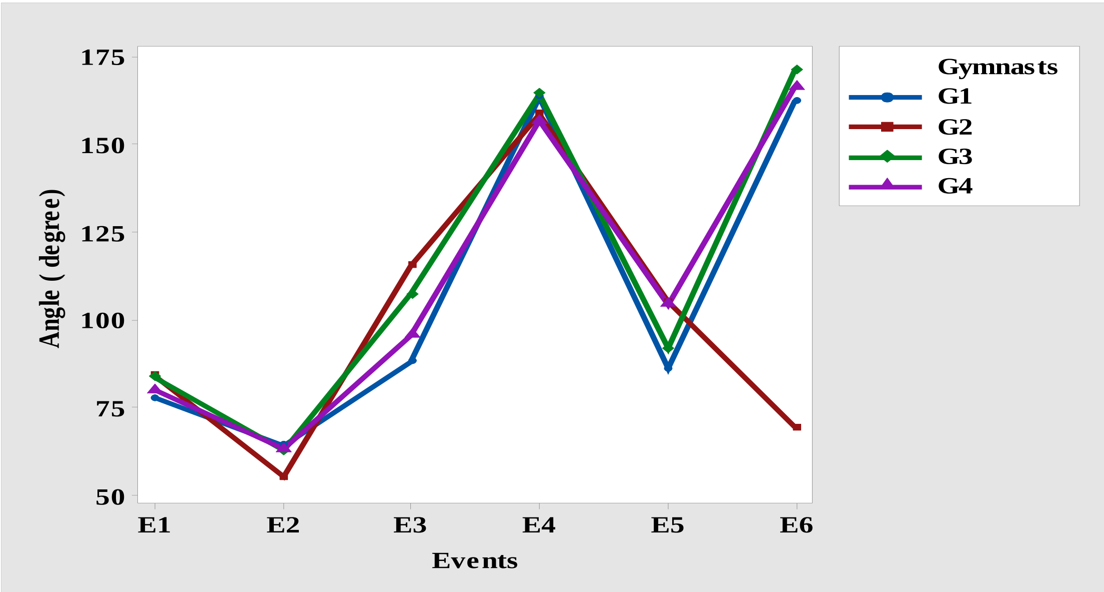
As shown in (Table 5), the average shoulder angle were(131.73deg) in E1, (154deg) in E2, (135.28deg) in E3, (113.55deg), in E4, (39.70deg) in E5, And (67.60deg) E6As shown in (Figure 6), while maintaining the extension

state before the take-off of the handspring in the hopping step, the shoulder joint angle is rapidly bent while taking off from the ground;it seems to control the body by extending the angle.
In a study by Oh-Seok Kwon and Yang-Jin Yoon [8].there was a statistically significant difference between E 5 and 38 deg and 82.7 deg, respectively. The air lobe motion is similar to the air lobe motion before bending the body. This is shown to reduce the turning radius and to obtain a larger rotation speed,

2) Hip angle

Table (6): show the angle of the shoulder joint of the front handsprung front tuck(Unit: degree)

Gymnasts	Events					
	E1	E2	E3	E4	E5	E6
G1	77.8	64.4	88.2	163.4	86.2	162.3
G2	84.2	55.3	115.5	158.6	105.1	69.41
G3	83.6	62.7	107.3	164.2	91.8	171.1
G4	79.9	63.2	95.5	156.5	104.3	166.3
M	81.38	61.40	101.63	160.68	96.85	167.28
SD	3.05	1.13	12.14	3.72	9.35	3.87



Figure(6): Hip angle

as shown in (Table 6) and (Figure 7). As shown in Table 6, when the handsprings are folded forward, the joint angles were (81.38deg) at E1, (61.40deg) at E2, (101.63deg) at E3, (160.68deg) at E4, (96.85deg) at E5, and (167.28deg) at E6.And as shown in (Figure 7), the hips are flexed until the hand stitches, while the hand springs are extended to the maximum extent until the jump. In order to obtain a sufficient amount of rotation after taking off from the ground, bending rapidly and passing over the peak to control the body is showing a form of expansion again.Oh-Seok Kwon and Yang-Jin Yoon [8].reported a statistically significant difference between E3 and E5 at 97.6deg, 106.2deg, and E5 at 77.5deg and 153deg, respectively, in the case of the aerial projection before the body flexion and the aerial projection before the body flexion , As well as the results of this study, similar results were obtained for the body protrusion. In order to carry out the aerodynamic motion before the bending of the handspring, it is necessary to bend the hip joint from the hop step until the hands and legs are worn, and then to lift the hip joint,It has been shown to have a positive impact. It is also necessary to extend the hip joint significantly in the backward air motion in order to perform a safe landing motion.

5. Body joint angular velocity

1) Shoulder angular velocity

Table (7): The shoulder angular velocities of the handspring frontal

Gymnasts	Events					
	E1	E2	E3	E4	E5	E6
G1	56.2	41.5	31.2	35.3	247.5	52.3
G2	202.6	114.4	219.5	11.6	1.2	292.7
G3	166.4	103.1	254.3	162.1	94.1	81.2
G4	154.5	113.2	31.5	564.3	223.4	121.5
M	144.92	72.3	134.12	193.32	29.25	50.02
SD	62.59	76.03	119.52	255.99	197.14	182.35

(Unit: deg/s)

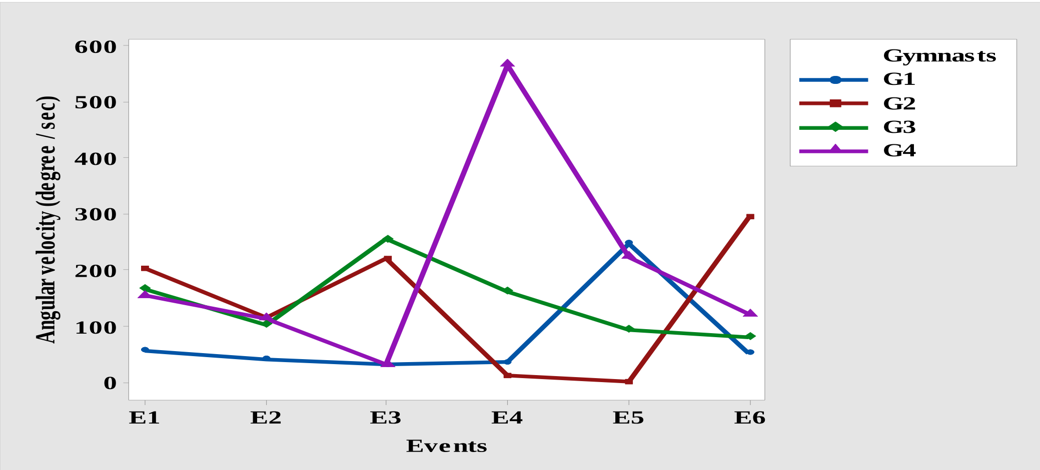


Figure (7): Shoulder angular velocity

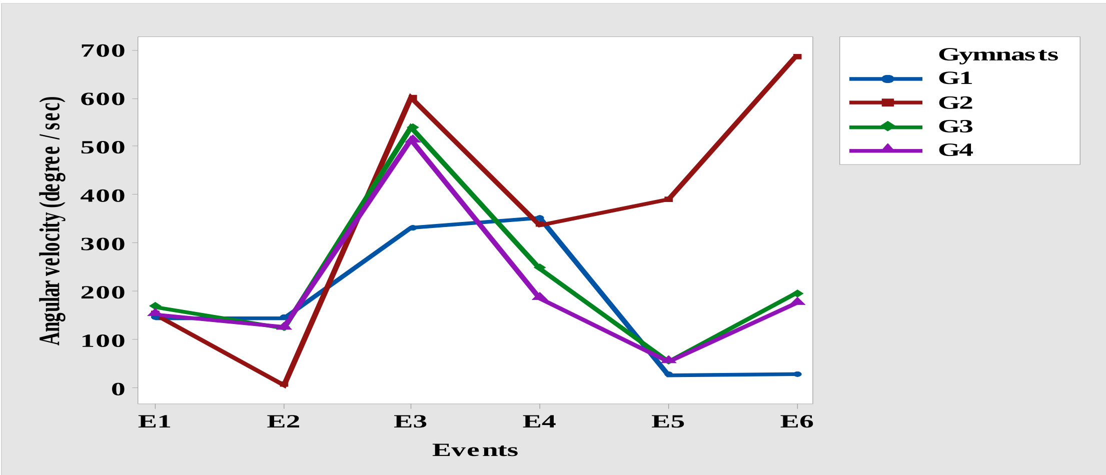
As shown in Table 7, the mean shoulder angular velocities of the shoulder joints at the front and back of the hand springs were (144.92deg / s) at E1, (72.3deg / s) at E2, (-134.12deg / s) at E3, (-193.32deg / s), (29.25deg / s) at E5, and (-50.02deg / s) at E6. As shown in <Fig. 8>, the shoulder angular velocity was fast during the hops step, and the slow angular velocity of the shoulder until the take-off after the hand spring operation was shown. It can be seen that the angle is bent. However, to control the body after the center of the body, the angular velocity of the shoulder appears as a negative value by extending the shoulder angle to control the body.As reported by Kinolik (1981), the larger range of motion determined by the front air jump depends on the action of the arm. This study suggests that the angular velocity of the shoulder flexibly changes to + It is thought that it will be advantageous to rotate.

3) Hip angular velocity

Table (8): show the angular velocity of front handspring front tuck.(Unit: deg/s)

Gymnasts	Events					
	E1	E2	E3	E4	E5	E6
G1	145.0	144.8	331.4	351.7	26.5	27.6
G2	153.0	6.5	601.5	338.3	391.0	685.6
G3	168.5	123.8	539.6	247.5	55.3	195.6
G4	152.3	125.7	513.2	186.4	54.6	176.0
M	154.7	96.95	496.42	280.97	90.95	183.2
SD	9.9	69.61	116.1	78.22	205.4	367.8

Figure(8):Hip angular velocity



As shown in Table 8, the average hip joint angular velocities at each of the phases in the hand-sprung frontal bend were (-154.7deg / s) at E1, (-96.95deg / s) at E2, (496.42deg / s) at (E3, 280.97deg / s) at E4, (90.95deg / s) at E5, and (183.8deg / s) at E6.As shown in <Fig. 9>, the angular velocity of the hip joint was fast due to the rapid extension of the hip joint from the hand dislocation to the take-off of the leg from the ground while showing a slow angular velocity from the hop step to the handgrip. After that, the angular velocity of the hip was slowed by flexing the hip joint angle for the public rotation, while the hip joint was decelerated to slow down the rotation speed and control the body.

The angular velocity of the hip joints rapidly increased with extension. In conclusion, it is important to make the hip joint angle faster after take-off from the ground to ensure a sufficient amount of rotation. By controlling the body by increasing the radius of rotation beyond the peak of the body center, itis thought that it will play a role.

And confirmed by Susan Abdel Moneim and others[11].about the importance of taking the body angles appropriate when skills performance, it helps to know the nature of muscle-based work on this and increase the angular velocity and linear speed means the acceleration of the body and then there should not be any stop between the parts of the movements, but must move So that these are interrelated mechanical concepts play a key role in performance.

Conclusion

1) A lot of time, it was enough to turn the player's movement in the air.
2) Shortening the time required until the hands are released and the hands are released from the hop step.
3) Quickly fold the body after leaving the ground in the 4th phase to secure a sufficient amount of rotation, and it is important to lengthen the time required by spreading the folded body in order to prepare for landing safely.
4) A short horizontal displacement was shown by folding the body to obtain a sufficient amount of turn to the maximum height, and a long horizontal displacement was obtained by extending the flexed body to perform a safe landing motion.
5) Vertical displacement continuously increased to the front air flight to increase the sufficient amount of rotation. On the other hand, the vertical displacement decreased again in the rear air flight past the body center peak
6) The hips are flexed until the hand stitches, while the handspring are extended to the maximum extent until the jump. In order to obtain a sufficient amount of rotation after taking off from the ground.
7) The shoulder angular velocity was fast during the hops step, and the slow angular velocity of the shoulder until the take-off after the handspring.

Recommendation

Intensive researches is needed to use kinematic analyzes to identify micro-events of all gymnastics activities, identify areas of problems in gymnastics activities, and promote mechanic and kinesiology analysis of gymnastics activities and vice versa.

References

1) Živčić,K.,Hraski,Ž.&Šadura,T.(1997).Detekcijakarakterističnihgrešakaranefazeučenjapremetanaprijed.[DetectionofCharacteristicExecutionErrorsinEarlyLearningStageoftheForwardHand-spring]. Croatian Sport-MedicineHerald,(1), 25 – 32.
2) Živčić,K.,Hraski,Ž.&Šadura,T.(1999).Usporedbadvanačinaizvedbepremeta

naprijed.[Compari-sonofTwoWaysofExecutingtheForwardHandspring]InD.Milanović(Ed.)ProceedingBookof2ndInternationalScientificConference,Dubrovnik,1999,"Kinesiologyforthe21stCentury"(pp.244-247).Zagreb:FacultyofPhysical Education,UniversityofZagreb.

3) Karascony I, Čuk I. Floor Exercises Methods Ideas Curiosities History. STD Sangvinčki. Ljubljana; 2005

4) Živčić K. Biomechanical evaluation of exercises to perform a somersault forward. Faculty of Kinesiology. Zagreb; 2000

5) Živčić K, Furjan-Mandić G, Horvatin-Fučkar M. The kinematic model of the bounce - off phase in some acrobatic elements with forward body rotation. FactaUniversitatis Series: Physical Education and Sport, 2007; 15: 9-18

6) H Joshi, G Ghai. Kinematic Comparison of two different Techniques of front flip tuck (Forward Somersault Tuck) on Floor Exercise in Men's Artistic Gymnastics, An International Peer Reviewed & Referred Scholarly Research Journal for Humanity Science & English Language, March, 2015 ISSN 2348-3083, Impact index: 1.795, Vol. II/VIII, (India).

7) Bae Nam Eun.(2003). A Kinematical Analysis of Forward Handspring Motio. Korean Journal of Sport Biomechanics, Vol. 13, No. 2, pp. 89-100.

8) Oh-Seok Kwon and Yang-Jin Yoon (2002). Comparative Kinematic Analysis of Handspring Salto Forward Tuckedand Handspring Salto Forward Stretched, The Journal, College of Education. Vol. 41 (2002)Pusan National University, Pusan, Korea, Vol.41 No.- [2002],199-216.

9) Kinolik, Z, Garhammer, J. 7 Gregor, R. T. (1981) Biomechanical comparison of frontal aerosolpositions. Biomechanics VII-B. 531-536.

10) Nelson N,G ,Mitos .M : Joint mobility and force application during the thrust phase of front handspring on floor exercises biomechanics in sports . Hungarian University of physical education, Budapest, Hungary1995;241-244.

11) Sawsan Abdel Moneim, Issam Mohamed Amin, Mohamed Sabry Omar, Mohamed Abdel Salam Ragheb (1991): Biomechanics in the sport Field, Second Edition, Knowledge House.p11.