ISSN No-2031-5063 Vol.1,Issue.I/July 11pp.1-4

Research Paper

COMPARISON OF KINEMATICAL VARIABLES BETWEEN SUCCESSFUL AND UNSUCCESSFUL FOSBURY-FLOP HIGH JUMP TECHNIQUE

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ABSTRACT
With the aim to compare the selected kinematical parameters of successful and unsuccessful Fosbury-flop high jump technique present study was structured. For the accomplishment of the purpose of this study six intervarsity level male high jumpers were randomly selected from the 70th All India Intervarsity Athletic Championship, held at Chennai, 2009. Their mean age, height and weight were 21 yrs, 170.87 cm and 60.5 kg, respectively. To acquire kinematical data during the competition, one high speed Sony DCR SX40E camcorder mounted at a height of 5 feet was placed at 10 meters away, perpendicular to the bar. All subjects were performed three jumps, and the successful and unsuccessful jump for each athlete was selected for further analysis. Video footages were downloaded, slashed to desired footages and edited for biomechanical analysis. Ankle angle, knee angle, hip angle, shoulder angle and elbow angle in different five phases (take-off preparation phase, take-off phase, flight phase, 'L' position phase and landing phase) were digitized with the help of Silicon Coach Pro7 motion analysis software. All statistical procedures were conducted using the SPSS (16.0 Version software. A level of significance was set at 0.05. The acquired data of the variables were subjected to descriptive statistical analysis followed by t test. The results showed that insignificant differences were found between successful and unsuccessful jump on selected parameters.

Key words: Biomechanics, High Jump, Flight and 'L' Position Phase

INTRODUCTION

Biomechanics is the study of the human body in motion. By applying principles from mechanics and engineering to study the forces that act on the body and the effects they produce (Bates, 1991). Hay (1973) describes biomechanics as the science that examine forces acting on and within a biological structure and the effects produced by such forces. Biomechanics is the science that investigates the effect of internal and external forces on human and animal bodies in movement and rest.

At the present age athletics is one of the most popular scenarios in Olympic Games. At times its emergence and professionalism in games and sports every nation wants to conquer the world with their sporting performance. Every athlete is working towards of biomechanics help to compete his opponent. During the recent years Fosbery-flop technique has taken the leading position at the competitions throughout the world where athlete has to sprint diagonally towards the bar, then curve and leap backwards over the bar.

Richard Fosbury used the backward twisting high jump technique for the first time at the Olympic Games in Mexico City in 1968. Despite the initial skeptical reactions from the high jumping community, the new technique quickly gained popularity, and is almost exclusively used by modern high jumpers. In the present day high jumping, the Fosbury-flop is the sole technique used by athletes at international, national and state level competitions too.

Fosbury-flop high jump technique has been divided into three parts–run-up, take-off and flight means bar clearance (Hay 1993). The run-up phase consists of a 'straight' run-up, perpendicular to the plane of the stands, followed by curved section during the last some steps before take-off. The run-up provides to athlete with optimum position for take-off, moving at a velocity consistent with the athlete's strength and skill. The take-off phase has been defined as a period of time between the instant of take-off foot first touches the ground and the instant it loses contact with the ground. Mechanical aspect the Fosbury-flop high jump are the peak height of center of mass during the flight over the bar, dependents on the height and vertical velocity of the center of mass at the toe-off instant. The height of the jumper's center of mass at instant of toe-off depends on velocity and position at that instant. Dapena, et al. (1990), have found a positive relationship between the horizontal velocity at the end of run-up and the vertical velocity of the center of mass during the end of take-off phase. The present study has been designed to compare the kinematical variables of successful and unsuccessful Fosbury-flop high jump technique of intervarsity level long jumpers.

METHODOLOGY

Subjects

Six male high jumpers were filmed during their competitive performances in the men's final high jump competition during the 70th All India Intervarsity Athletic Meet 2009-10 held at Chennai. The best valid (successful) and unsuccessful jumps from each of the jumpers were selected for the further analysis.

Tool and Equipments

Biomechanical analysis demands specific tools and equipments to capture and analyze the data. The experimental apparatus used in this research work were camcorder (DCR SX40E), tripod, measuring tap the downloaded version of STHVCD55 Software, Silicon coach pro-7 (motion analysis software) and computer system.

Collection of Data and Filming Protocol

For the kinematical data a high speed camcorder (Sony DCR SX40E), operating at 1/2000 with a frame rate of 60 frames per second, was used to capture the whole procedure. The camcorder was placed perpendicular at a distance of twelve meters on the right side of the bar mounted at a height of one meter above ground and capture video clips of sufficient coverage to clearly see the complete motion. All the attempts of the selected subjects were recorded during competition, when they cleared the bar on a particular height that was taken as successful jump and when they were unable to clear the bar at the same height was taken as unsuccessful jump. The recorded video footages were downloaded, slashed and edited by using the downloaded version of STHVCD55 software. Digitization, smoothing and analysis were conducted using the Silicon Coach Pro7 (motion analysis software). The kinematic variables which were

selected in the present study were segmental (ankle, knee, hip, shoulder and elbow) angles in different five phases (take-off preparation, take-off, flight (above the bar), 'L' position and the landing). Acquired data were subjected to statistical analysis independent sample t test for the comparison of the kinematic parameters between successful and unsuccessful jump. All statistical procedures were conducted using the SPSS 16.0 software. A level of significance was set at 0.05 with 10 degree of freedom.

RESULTS

The most important aspect of any researcher is to reach at last inferential point, for this the raw data were arrange sequentially, tabulated and subjected for the descriptive statistical analysis, followed by t test by using SPPS (16.0) to distinguish if there were any difference across the different parameters between successful and unsuccessful Fosbury-flop high jump technique. The researcher reached at the results of this empirical investigation which is presented by the respective tables and graphs.

Table 1: Indicating mean differences of ankle at different phase between successful and unsuccessful Fosbury-flop high jump technique

Phases	Mean & SD	Successful	Unsuccessful	t value
Phase-1	Mean	97°	91.5°	0.49
	SD	1.41	18.88	
Phase-2	Mean	147.67°	145.17°	0.56
	SD	3.27	9.72	
Phase-3	Mean	105.17°	124.33°	0.01
	SD	11.77	7.71	
Phase-4	Mean	101.33°	112.5°	0.18
	SD	9.24	16.48	
Phase-5	Mean	108.5°	115.5°	0.38
	SD	17.39	7.26	

Since (t) calculated is less t.05, 04 than therefore, this shows that the mean do not differ significantly at 0.5 level between successful and unsuccessful Fosbury-flop high jump technique in their angle of the ankle joint in all the phases.

Table 2: Indicating mean differences of knee at different phase between successful and unsuccessful Fosbury-flop high jump technique

Phases	Mean & SD	Successful	Unsuccessful	t value
Phase-1	Mean	161.83°	160.33°	0.61
	SD	3.97	5.68	
Phase-2	Mean	168°	172.17°	0.10
	SD	4.86	3.00	
Phase-3	Mean	83.5°	93.83°	0.42
	SD	24.88	16.95	
Phase-4	Mean	158.17°	153.5°	0.69
	SD	24.62	12.18	
Phase-5	Mean	160°	155.5°	0.47
	SD	5.62	13.56	

Since (t) calculated is less t.05, 04 than therefore, this shows that the mean do not differ significantly at 0.5 level between successful and unsuccessful Fosbury-flop high jump technique in their angle of the ankle joint in all the phases.

Table 3: Indicating mean differences of hip at different phase between successful and unsuccessful Fosbury-flop high jump technique

Phases	Mean & SD	Successful	Unsuccessful	t value
Phase-1	Mean	154.17°	153°	0.74
	SD	5.49	6.23	
Phase-2	Mean	165.17°	164.17°	0.83
	SD	10.38	4.36	
Phase-3	Mean	152.17°	147.33°	0.52
	SD	9.39	14.83	
Phase-4	Mean	98.33°	85°	0.27
	SD	11.24	25.76	
Phase-5	Mean	78°	71.17°	0.63
	SD	28.50	18.58	

***Significant at .05 level of Significance t0.05, 04 = 2.78**

Since (t) calculated is less t.05, 04 than therefore, this shows that the mean do not differ significantly at 0.5 level between successful and unsuccessful Fosbury-flop high jump technique in their angle of the hip joint in all the phases.

Table 4: Indicating mean differences of shoulder at different phase between successful and unsuccessful Fosbury-flop high jump technique

Phases	Mean & SD	Successful	Unsuccessful	t value
Phase-1	Mean	66.83°	73.33°	0.83
	SD	48.01	51.78	
Phase-2	Mean	133°	143.83°	0.61
	SD	39.05	31.01	
Phase-3	Mean	54.33°	35.83°	0.39
	SD	49.91	3.87	
Phase-4	Mean	64.33°	55.5°	0.29
	SD	12.69	14.67	
Phase-5	Mean	83.5°	91.67°	0.71
	SD	41.26	32.61	

***Significant at .05 level of Significance t0.05, 04 = 2.78**

Since (t) calculated is less t.05, 04 than therefore, this shows that the mean do not differ significantly at 0.5 level between successful and unsuccessful Fosbury-flop high jump technique in their angle of the shoulder joint in all the phases.

Table 5: Indicating mean differences of elbow at different phase between successful and unsuccessful Fosbury-flop high jump technique

Phases	Mean & SD	Successful	Unsuccessful	t value
Phase-1	Mean	117.50°	101.17°	0.55
	SD	27.30	58.06	
Phase-2	Mean	100.5°	111.67°	0.61
	SD	45.10	27.19	
Phase-3	Mean	153.67°	161°	0.35
	SD	17.75	3.80	
Phase-4	Mean	112.5°	103.33°	0.69
	SD	43.50	32.13	
Phase-5	Mean	108.17°	105.33°	0.90
	SD	25.44	44.70	

***Significant at .05 level of Significance t0.05, 04 = 2.78**

Since (t) calculated is less t.05, 04 than therefore, this shows that the mean do not differ significantly at 0.05 level between successful and unsuccessful Fosbury-flop high jump technique in their angle of the elbow joint in all the five phases.

FIGURE 1.1: SHOWING COMPARISON OF ANKLE ANGLE BETWEEN SUCCESSFUL AND UNSUCCESSFUL FOSBURY-FLOP HIGH JUMP TECHNIQUE

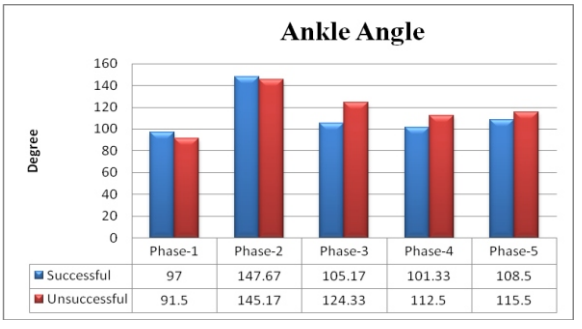


FIGURE 1.2: SHOWING COMPARISON OF KNEE ANGLE BETWEEN SUCCESSFUL AND UNSUCCESSFUL FOSBURY-FLOP HIGH JUMP

TECHNIQUE

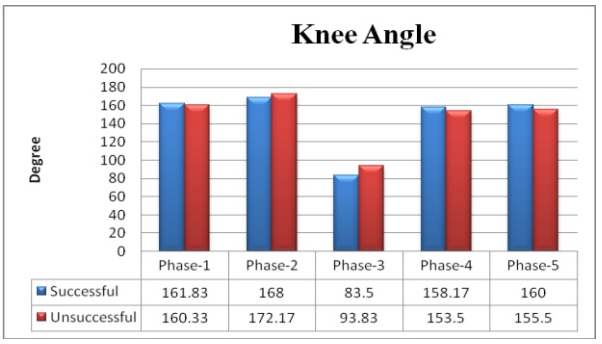


FIGURE 1.3: SHOWING COMPARISON OF HIP ANGLE BETWEEN SUCCESSFUL AND UNSUCCESSFUL FOSBURY-FLOP HIGH JUMP TECHNIQUE

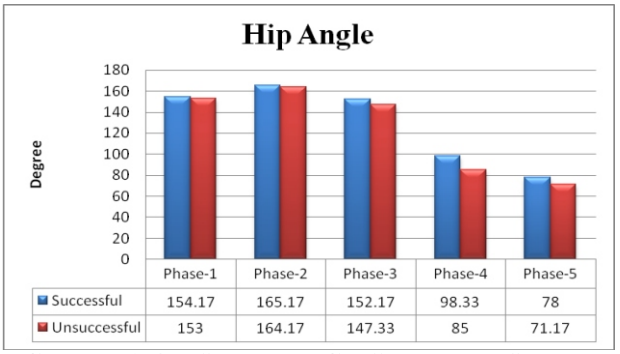


FIGURE 1.4: SHOWING COMPARISON OF SHOULDER ANGLE BETWEEN SUCCESSFUL AND UNSUCCESSFUL FOSBURY-FLOP HIGH JUMP TECHNIQUE

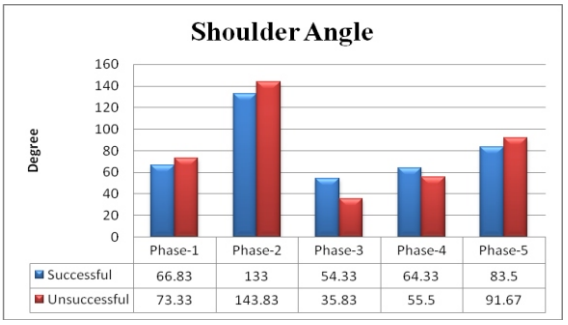
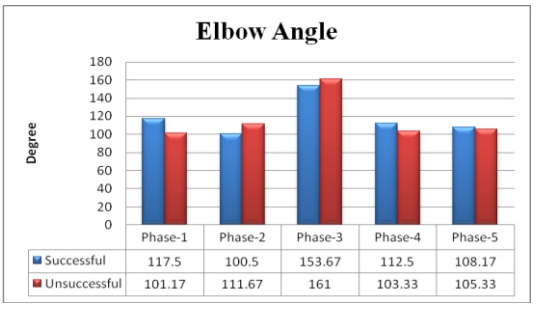


FIGURE 1.5: SHOWING COMPARISON OF ELBOW ANGLE BETWEEN SUCCESSFUL AND UNSUCCESSFUL FOSBURY-FLOP HIGH JUMP TECHNIQUE



DISCUSSSION

As documented from the results of this study it is concluded that insignificant differences were found between successful and unsuccessful Fosbury-flop high jump technique of intervarsity level high jumpers in their ankle angle, knee angle, hip angle, shoulder angle and elbow angle in different phases because all the calculated t values were greater than tabulated t value. The insignificant result is due to the fact that the variation in the angle of successful and unsuccessful is very small. It is not necessary for player to have the same segmental or angle variation to perfection. One player can have low angle at knee or hip or elbow etc. at the other hand other can have high angle at knee or hip or elbow etc. and both can get the success in the high jump. It clearly defines for the result of the study that the Fosbury-flop technique can have any segmental angle variation to get successful jump.

CONCLUSION

Based upon the study's finding, it is concluded that there was insignificance difference found between successful and unsuccessful Fosbury-flop technique of elite Indian high jumpers in their ankle angle, knee angle, hip angle, shoulder angle and elbow angle in different phases because the difference between successful and unsuccessful jump was very minor. Here we can also conclude that the crossbar definitely falls off several different ways and the way the crossbar falls off can indeed indicate the possibilities of what the jumper has done incorrectly. A missed jump, therefore, can be very useful to the development of a jumper, and a miss must be analyzed as much, if not more than, a successful jump.

REFERENCE

Ae, M., Sakatani, Y., Yokoi, T., Hashihara, Y., and Shibukawa, K. (1986). Biomechanical analysis of the preparatory motion for takeoff in the Fosbury Flop. International Journal of Sport Biomechanics, 2, 66 – 77.

Chu, D., and Humphrey, S. (1981). The high jump – the Flop high jump. In V. Gambetta (Ed.), Track and field coaching manual '81 (pp. 173 – 180). West Point, NY: Leisure Press.

Dapena, J. (1997). The Rotation over the Bar in High Jumping. In Proceedings of the 4th International Olympic Committee World Congress on Sport Sciences, October 22-25: (pp. 35). Monte Carlo, Monaco: IOC.

Dapena, J. (1980a). Mechanics of translation in the Fosbury-flop. Med. Sri. Sports Exerc. 12:37-44.

Dapena, J. (1980b). Mechanics of rotation in the Fosbury-flop. Med. Sri. Sports Exerc. 12:45-53.

Dapena, J. (1988), Biomechanical analysis of the Fosbury-flop. Track Technique 104:3307-3317;3333;105:3343-3350.

Dapena, J. (1995), How to design the shape of a high jump run-up. Track Coach 131, Spring.

Hay, James. (1988), Approach Strategies in the Long Jump. International Journal of Sports Biomechanics, Vol.4, 114-129.

Hay, J.G., Miller, J.A. Jr. and Canterna, R.W. (1986). The Techniques of Elite Male Long
Jumpers. Journal of Biomechanics, Vol. 19, 855-866.

Humphrey, S. and Nordquist, D. (2000). High Jump. In USA Track and Field Coaching Manual (Joseph Rogers, Editor). Human Kinetics.