BIOMECHANICAL ANALYSIS OF THE MEN'S JAVELIN THROW AT THE 21ST SOUTH EAST ASIAN GAMES

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A three-dimensional video analysis was performed on four finalists in the javelin throw of the 21st South East Asian (SEA) Games. The release parameters of the performances of the men's javelin finals are presented in this paper. The performance parameters were compared with that of the 19th SEA Games (Xie et al, 2001) to evaluate if improvements were made. The release parameters were also compared with the 1995 World Championship reported by Morriss et al (1997) to provide an international perspective for the level of performance. The data collected from this SEA Games facilitated the comparison between the South East Asian athletes and the world-class athletes to provide an international perspective of sports performance.

KEY WORDS: javelin, analysis, south-east, asian.

INTRODUCTION: Biomechanical analyses on performances of elite athletes from the South East Asian (SEA) countries are few in numbers and are not well documented. In 1997, Singapore Sports Council has initiated an ongoing biomechanics project with collaborations from the host countries of the South East Asian Games to encourage biomechanical analyses so that a resource of biomechanical performance data can be obtained to provide coaches and athletes of this region with quantitative information to improve performance. This is the second javelin study that has been conducted under this project. In a previous study (Xie et al., 2001) the last cross over stride and release parameters of the men's javelin throw in the 19th SEA Games were examined. In this study two throwers with throwing distance beyond seventy metres were analyzed and were compared with the finalists of the 1995 World Championship reported by Morriss et al. (1997). It was noted that the SEA Games athletes had a much slower release speed and smaller release angle. It was hoped that the findings would assist the SEA Games throwers in improving their performance. Therefore, the purpose of the present study is to examine the kinematics of the men's javelin performances in the recent 21st SEA Games so as to evaluate if improvements has been made. The recent 21st SEA Games were held in Kuala Lumpur, Malaysia, (September 2001). In order to facilitate evaluation of performances, the release parameters of the javelin throws at this Games were obtained by video analysis and compared with the data collected in the 19th SEA Games (reported by Xie et al., 2001) and also with the data of the 1995 World Championship (reported by Morriss et al.,1997).

METHODS: Three-dimensional video data of the men's javelin event at the 21st SEA Games was collected using a fixed two-camera system, operating at 50 Hz. The positions of cameras are shown in Figure 1. Twenty-one throws from the four throwers were recorded and analyzed. Cameras were aligned with their optical axes approximately horizontal and intersecting at about 90°. In order to calibrate the performance area for the throws, a Peak calibration frame (2.2 m x 2.2 m x 1.6 m) of 25 control points was placed on the throwing runway about 3.17 meters from the foul line. The calibration frame was video recorded using the two cameras. The control points were digitized to obtain the necessary parameters for three-dimensional reconstruction from the different planar images using the Direct Linear Transformation (DLT) method. Once the calibration frame was video recorded, caution was taken to ensure that the location of the cameras remained unchanged throughout the video recording of the javelin throws. The video images of the javelin throws were recorded at 50 Hz. Twenty body landmarks of the thrower and two points on the javelin (namely the grip and the tip of the javelin) was digitized using the Peak Motus motion analysis system. The three-dimensional co-ordinates were reconstructed by the DLT method. The reconstructed

coordinates were smoothed using the low-pass Butterworth filter (6 Hz). The basic factors determining the distance with which an athlete is credited in the javelin throw are: the speed, height, and angle at which the implement is released and the aerodynamic factors that influence its flight (Hay, 1993). This study seeks to examine the speed, height and the angle of javelin release among the finalists of the 21st SEA Games. The release speeds were estimated as the first derivative of the grip position of the javelin at the frame prior to the release of the javelin. The release angle of the javelin was taken as the angle of the release velocity vector relative to the horizontal. The release height or the launch height is measured from the grip of the javelin to the ground at the moment of release. In order to examine if the thrower maximized the distance of throw, the horizontal distance X_0 between the tip of the javelin and the foul line of the throwing runway was noted at release (indicated as R in Figure 1). Theoretically, if the tip of the javelin is exactly at the foul line at release, X_0 would be zero, the thrower would have fully maximized his throw. Hay and Reid, (1988) referred this distance as the release distance. Hence the release speeds, angles, heights and the distances (X_0) were acquired from the video analyses and compared with the performances in the 19th SEA Games as well as the data reported by Morriss et al. (1997)

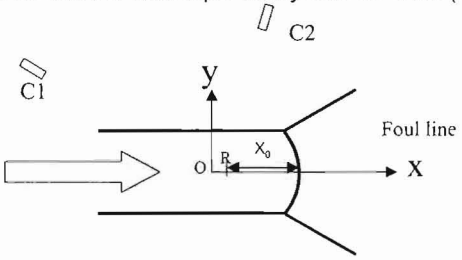

Figure 1. Camera placement and coordinate system of javelin final.

RESULTS AND DISCUSSION: In this study, the best throws of each of the 21st SEA Games javelin finalists were examined. The performance parameters of the throwers are presented in Table 1. For comparison, the performance parameters of two of the 19th SEA Games javelin throwers are also listed. The release speed of the javelin is generally considered as the most critical factor determining throwing distance (Whiting et al., 1991). The release speeds of the javelin throwers in 21st SEA Games ranged from 23.0m/s to 26.3m/s. The release speeds of the throwers in this SEA Games were relatively slower than those reported for the 1995 World Championship throwers (28 – 30 m/s). In comparison with the 19th SEA Games results, the release speeds were also slower. Only one throw performed by Thirdsak (the winner of the 21st SEA Games javelin event) had a release speed surpassing the performance of Mahuse and Yazid of the 19th SEA Games. Morriss et al. (1997) attributed the better throwing distance between two elite throwers to a higher release angle when the other release parameters were similar. The release angles of the four javelin throwers in this SEA Games ranged from 33.6° to 40.2°. Besides Thirdsak's exceptionally low release angle, (he was noted to have released the javelin at 33.6°) the average release angle of the throwers at this SEA Games (37°) were similar to that of the World Championships athletes (38°). It was also larger than that recorded at the 19th SEA Games (35.6°). The release heights of the throws in the 21st SEA Games ranges from 1.78 to 1.89m. The average release height of this SEA Games (1.83m) was slightly higher than the 19th SEA Games (1.80m) but was noticeably lower than that of 1995 World Championship (1.97m). Bottchner and Kuhl (1998) claimed that there is an optimal release height in javelin throwing. However, Coh et al, (2001) were of the opinion that the release height of a throw is mostly defined by the height of the athlete. Perhaps the lower release heights of the SEA Games throwers were results of their comparatively smaller physical statures when compared with the throwers of the World Championships. It would be interesting to examine the anthropometric characteristics of the SEA javelin throwers in a future study. The magnitude of the release distance is indicative of how a thrower can maximize their throws. Hay (1993) claimed that an athlete needs only a 1.5–2.0m long recovery step to dissipate the momentum left over from the preceding movements. The results show that the 21st SEA Games throwers were on average releasing the javelin at about 2.55m before the foul line.

Table 1. Performance parameters.

19th SEA Games	Rank	official height release (m)	angle of release (m)	distance (m)	Z (m/s)	Xo speed release (deg)
Mahuse	1	69.62	1.81	2.04	25.2	36.4
Yazid	2	67.94	1.79	3.16	25.1	34.9
21st SEA Games						
Thirdsak	1	68.52	1.87	3.05	26.3	33.6
Dandy	2	65.66	1.79	2.06	24.0	37.4
Kyaw	3	62.97	1.89	2.50	23.2	36.8
Sanya	4	61.15	1.78	2.62	23.0	40.2

Z is the height of release

Although this is a slight improvement from the 19th SEA Games (where the throwers were releasing their javelins on average 2.6m from the foul line) much can be done to maximize their throws. Taking into the consideration that a recovery step length of 2.0m is necessary, there is still half a meter or more to be maximized.

CONCLUSIONS: The average release speeds of both the SEA Games' javelin throwers were less than that of the 1995 World Championships. The average release angle of the 21st SEA Games javelin throwers was slightly greater than the throwers of the 19th SEA Games but similar to that performed by the throwers of the 1995 World Championship finals. The SEA Games throwers were noted to release the javelin at a lower height. This may be indicative of their smaller physical statures. The SEA Games throwers' average release distance is about 2.6m from the foul line. This is one remediable area for the SEA Games throwers. When comparing the performances of the javelin throwers in these two SEA Games, only Thirdsak (the gold medallist of the 21st SEA Games) has a release speed (26.3m/s) that exceeds that of the gold and silver medallists in 19th SEA Games. However, his lower release angle (33°) may have deprived him of even better performances. If Thirdsak can improve on the release angle, he might be able to throw beyond 70 m. The biomechanics project of the SEA Games provided an opportunity for the sports biomechanists of the SEA regions to work co-operatively and yielded useful quantitative information on techniques used by the athletes in the Games. Coaches could use this information to recommend intervention strategies to enhance the performance of their athletes. The data collected from the Games facilitated the comparison of critical biomechanical parameters between the South East Asian athletes and the world-class athletes to provide an international perspective of sports performance.

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