MALE AND FEMALE ELITE MALAYSIAN AIR RIFLE SHOOTER: A PRELIMINARY STUDY

Y.Selva[1], Saju Joseph[1] and A.F.Salleh[2]

National Sports Institute of Malaysia[1]
Universiti Malaysia Perlis[2]

Shooting is sport that involves precision and consistency. In order to achieve high score, shooters are encouraged to minimize movements. One of the parameter that is commonly used to measure stability of movement is body sway. Commonly used parameter to measure body sway is displacement velocity. Shooting is a static sport and as the number of shots increases, athletes are bound to feel more fatigue. The purpose of the data collection is to investigate how the increasing number of shots influences the displacement velocity parameters and if the variables influence the score obtained by the athletes. 2 shooters (1 male and 1 female) were involved in this study. The data collection was conducted abiding the format of international shooting competition where male athletes shoot 60 shots in 75 minutes while female athletes shoot 40 shots within 50 minutes. Tekscan insoles were utilized to obtain data from the athletes. Data of athletes were analyzed using the SPSS16 software. There were no correlations found between the investigated parameters and score. However, there are correlations with weak and moderate strength that was found between investigated stability variables.

KEYWORDS: Shooting, air rifle, body sway

INTRODUCTION: More than 15 categories are competed in the Olympic sport shooting. From these lists, one of the most technical categories is the standing air rifle as it requires extreme precision to ensure success. From this position, the athletes has to aim at a target placed 10 m away containing a 'ten- ring' or 'bull's-eye' that is only 1 mm in width (Ball, Best, & Wrigley, 2003). In order to achieve success, the shooters will have to control their body as well as rifle fluctuations. This is different from another discipline of shooting known as biathlon which uses coincidence-anticipation strategies (Baca & Kornfeind, 2012). While aiming, postural stability is considered as the consequence of the gravity's interaction with the mechanical properties of the locomotor system as well as the control process (Gianikellis, Pantrigo, & Vara, 2001). As shooting is a precision sport even a change in the posture could result in a poor shot. Controlling oscillations and keeping a stable posture is thus crucial (Era, Konttinen, Mehto, Saarela, & Lyytinen, 1996).

In shooting, motor and perceptual systems are tightly interconnected. Control over aiming and shooting is achieved by an individual using a fine level of visuomotor interaction which also demands a high degree of spatial resolution and paired with low tolerance for deviation from an intended target (Goodman, Haufler, Shim, & Hatfieldd, 2009). Higher level shooters are expected to have lower body sway although the motor strategy is assumed to be similar in all levels. Furthermore, elite shooters are assumed to use psychomotor effort to remain in a state of 'alert immobility' while non-elite shooters appears to be reliant more on visual spatial targeting. This could be an attempt to find an appropriate moment of steadiness prior to pulling the trigger (Konttinen, Lyytinen, & Viitasalo, 1998). As higher level shooters are expected to have less body sway, naturally, it is assumed that those shooters with lower body sway tend to have an advantage of becoming a better shooter.

Correlation has been found between body sway and movements of the gun barrel. It is also found in direct correlation in pistol specific tests in 80% of the cases. Body sway is also expected to result with variability in performance about 53% amongst elite pistol shooters (Mon, Zakynthinaki, Cordente, Barriopedro, & Sampedro, 2014). An increase in body sway is also associated with increases in the movement of gun barrel in rifle shooting (Mon et al., 2014).

Body sway was found to influence performance of shooters in previous studies. However, the numbers of shots investigated are not the same as in actual competition. Other than that,

previous investigators did not study displacement velocity individually on each feet and its effect on score. Hence, this study was conducted to investigate how the increasing number of shots influences the displacement velocity parameters and if the variables influence the score obtained by the athletes.

METHODS: 2 national level Malaysian shooters (1 male and 1 female) were involved in this study. Data collection was conducted at the shooting range in Bukit Jalil. The session was conducted in accordance to the format of international shooting competition where the male athlete is required to fire 60 shots within 75 minutes and female athlete is required to shoot 40 shots within 50 minutes. The time utilized by athlete to fire each shot is dependent on the preference of the athlete. Athletes were permitted to wear shooting jacket and shoes during the data collection.
A sound sensor that detects the sound of shot and stops data recording was utilized to accurately mark the bullet release from the rifle was synchronized with the tekscan software. The recordings are begun once the athlete starts to aim at the target and ended once the bullet is released by the gun. Tekscan insoles were utilized to obtain data from the athletes. The insoles were cut according to the size of athlete's feet and fitted into the shoes of athletes. The sensors are then calibrated using the body weight of the athletes. Data is then processed using the tekscan grip research software. Displacement velocity parameter for three seconds prior to shot release for each shot was cut, exported and analyzed using Microsoft Excel. The standard deviation of displacement velocity during each shot was compiled. If there are data missing in a particular trial, the trial is excluded from the analysis. SPSS16 was used to analyze the correlation between parameters.

RESULTS AND DISCUSSION:

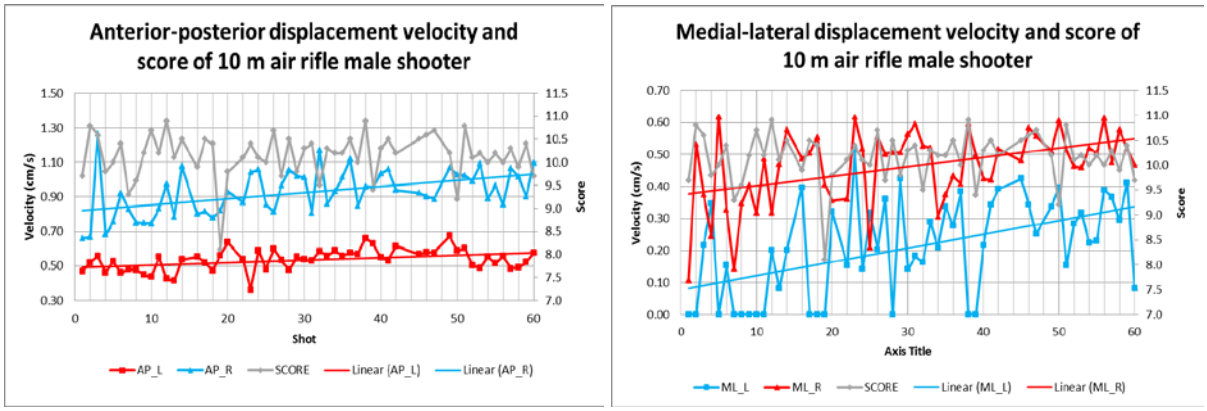

Figure 1: Anterior posterior displacement velocity and medial-lateral displacement velocity of 10 m air rifle male shooter.

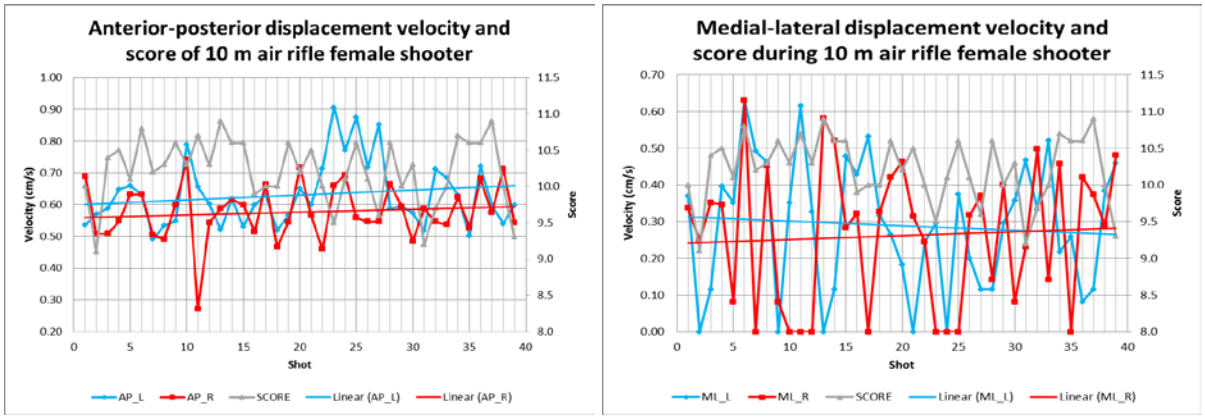

Figure 2: Anterior-posterior displacement velocity and medial-lateral displacement velocity of 10 m air rifle female shooter.

Based on the trendline fitted, both male and female athlete show an increase in left and right anterior-posterior (AP_L and AP_R) displacement velocity as the number of shot increases. Furthermore, the AP_L is higher than AP_R for both athletes. However, in terms of medial-lateral displacement velocity of left and right feet (ML_L and ML_R), the male air rifle shooter show a steep increase based on trendline fitted. The female athlete show a higher velocity in left feet initially. After the 31st shot, the trend changes and the velocity exerted by right feet is higher than left feet after that particular shot.

Table 1: Correlation value for 10m air rifle shooter male

Variables	Left_ Feet	Right_ Feet	AP_L	AP_R	ML_L	ML_R
Left_Feet	1					
Right_Feet	-1.000**	1				
AP_L	0.009	-0.009	1			
AP_R	0.257	-0.257	.289*	1		
ML_L	.268*	-.268*	0.112	.361**	1	
ML_R	.286*	-.286*	.303*	0.253	0.182	1
Score	0.052	-0.052	-0.07	0.101	0.066	0.226

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Weak correlation was found between the percentage of body weight placed on left feet (Left_Feet) and medial-lateral displacement velocity of right feet (ML_R) (r =0.286) ,between anterior-posterior displacement velocity of left and right feet (r =0.289), between medial-lateral displacement velocity (ML_R) of right feet and anterior-posterior displacement velocity of left feet (AP_L) (r =0.303), and also between the medial-lateral displacement velocity of left feet (ML_L) and anterior-posterior displacement velocity of right feet (AP_R) (r =0.361). Weak negative correlation exist between the percentage of weight placed on right feet (Right_Feet) and the medial-lateral displacement velocity of left feet (ML_L) (r = -0.268) and right feet (r = -0.268).

Table 2: Correlation value for 10 m air rifle shooter female.

Variables	Left_ Feet	Right_ Feet	AP_L	AP_R	ML_L	ML_R
Left_Feet	1					
Right_Feet	-1.000**	1				
AP_L	-.592**	.592**	1			
AP_R	-0.004	0.004	0.189	1		
ML_L	0.048	-0.048	-0.08	-0.252	1	
ML_R	0.314	-0.314	-0.215	0.081	-0.149	1
Score	0.245	-0.245	-0.157	0.005	-0.119	0.086

**. Correlation is significant at the 0.01 level (2-tailed).

For the female shooter, there is positive moderate correlation between the anterior-posterior displacement velocity of left feet and the percentage of body weight placed on right feet (r = 0.592). Besides that, there is also a moderate positive correlation between the percentage of weight placed on right feet and anterior-posterior displacement velocity of left feet (r = 0.592). Based on data obtained from Table 3, the female athlete was found to exert higher maximum anterior-posterior displacement velocity than male athlete. However, when minimum anterior-posterior displacement velocity was compared, the minimum value the male athlete exerted was higher than the female athlete. In terms of medial-lateral displacement velocity, the same condition was found. Both the male and female athlete were able to achieve the highest score which is 10.9. The minimum score achieved by the male athlete is however lower than the female athlete. The average of total score achieved by both athletes reveals that both athletes obtained an average score of 10.2 respectively.

Table 3: Descriptive data of male and female athletes

Variables/ Gender	MAX AP_L	MAX AP_R	MIN AP_L	MIN AP_R	MAX ML_L	MAX ML_R	MIN ML_L	MIN ML_R	Total Score	MAX Score	MIN Score	AVG Score
Male	0.67	1.27	0.36	0.66	0.51	0.62	0.00	0.11	558.3	10.9	8.1	10.2
Female	0.91	0.74	0.49	0.27	0.63	0.63	0.00	0.00	398.4	10.9	9.1	10.2

The findings from this study is also in line with the findings from a study by (Era et al., 1996) which found that the changes in the medial-lateral displacement velocity is lower than in anterior-posterior direction. It was also found that the male athletes show lower speed in the anterior-posterior and medial-lateral direction compared to female athletes.

CONCLUSION: In conclusion, the performances of athletes are individualized. Significant variables that shows correlation differs between both athletes. Although the female athlete shows a higher value of displacement velocity than the male athlete, the average score obtained by both athlete is the same. This finding is parallel to the statistical findings of no correlation between the score and investigated parameters for both atheletes. However, there are correlation between the displacement velocity parameters. This is an indication that changes in terms of velocity in one direction in turns affects the velocity in other direction. There were also correlation between changes of velocity in one feet with another. Therefore, changes in terms displacement velocity that happens in one feet can also affect another feet. Based on previous litereature, assessment of athletes body sway was not segregated to left and right feet. The findings from this studies reveals that changes that occurs in both feet is not necessarily cohesive. As the displacement velocity of the athletes is also influenced by the percentage of weight placed on each feet, coaches could place a higher attention to the the effect of posture adapted by their athlete and its effect on their body weight distribution. Sports scientist's too should take this into consideration in future investigations.

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