

THE EFFECTS OF THE UPRIGHT BODY TYPE EXERSIZE PROGRAM ON FOOT PLANTAR PRESSURE OF ARCHERS

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This study is aimed to analyze how the upright body type exercise program, a spine stabilization exercise program, increases in upper limbs motility control of archers and affects foot plantar pressure of archers by stabilizing body balance in order to prove the effectiveness of upright body type exercise, and, on this basis, provide a new effective and efficient training program. To determine how the 12-week(3 times a week) upright body type exercise program affected plantar pressure of archers, a total of 10 archers—3 men and 7 women—in B Metropolitan City who had more than 10 years of career in archery were sampled. The upright body type exercise program had positive effects on static and dynamic balance of foot plantar pressure by allowing archers to experience less body sway and physical imbalance in shooting and with closed eyes. So the program is expected to help archers correct their posture, become psychologically stable, and make better performance.

KEY WORDS: shooting, foot plantar pressure, static balance, dynamic balance

INTRODUCTION: Athletics such as archery that requires using muscles partially and spinal strength cause athletes spinal imbalance a lot, which can cause archers pains in the scapula, neck, back, and etc. These pains are caused wrong postures, or mal-alignment, or overload on the upper limbs by constant movement. Thus, exercising using partial muscles or in wrong posture for a long time can cause alter the body shape and imbalance in muscular development (Yoon, Kim, 2012). Due to wrong instructions of coaches or excessive training of athletes, most archers have asymmetry and imbalance in their postures (Kim, 2008). The upright body type exercise program has been developed based on clinical case studies conducted on 12,000 people for six years from 2009 to 2014, March, in order to increase in synthetic effect of joints, skeletons, and muscles and to keep up the right body shape by aligning skeletal and spinal systems (Kim, 2015).

This study is aimed to analyze how the upright body type exercise program, a spine stabilization exercise program, increases in upper limbs motility control of archers and affects foot plantar pressure of archers by stabilizing body balance in order to prove the effectiveness of upright body type exercise, and, on this basis, provide a new effective and efficient training program. The upright body type exercise program had positive effects on static and dynamic balance of foot plantar pressure by allowing archers to experience less body sway and physical imbalance in shooting and with closed eyes. So the program is expected to help archers correct their posture, become psychologically stable, and make better performance.

METHOD: To determine how the upright body type exercise program affects plantar pressure of archers, a total of 10 archers(3 men and 7 women) in Busan Metropolitan City who had more than 10 years of career in archery were sampled.

As shown in <Figure 1> and <Table 1>, upright body type exercise program was conducted



Figure 1. Upright Body Type Exercise



Figure 2. Analysis of dynamic balance of foot plantar pressure in shooting

for 12 weeks(3 times a week). As for the exercise intensity, it was conducted in RPE(Rating of perceived exertion) 11~12 during the first 6 weeks, and in RPE 13~14 during the remaining 6 weeks.

Table 1. Upright body type exercise program

Division	Intensity	Frequency	Time	Type
Warming up		3times/week	10min	Flexibility exercises, stretching, massage
Main exercises	RPE 11-12 (6 weeks) RPE 13-14 (6 weeks)	Hip joint exercise (20times)	40min	Both exercise (Gym mate) After each exercise Stretch three times
		Pelvis exercise 1 (10sec)		
		Pelvis exercise 2 (3min)		
		Shoulder exercise (3min)		
		Back exercise 1 (3times)		
		Neck exercise (3times)		
		Back exercise 2 (3times)		
Knee exercise (5times)				
Cooling down		Flexibility exercises, stretching, massage	10min	Flexibility exercises, stretching, massage

To measure the plantar pressure distribution, resistance pressure sensor, Gaitview AFA-50(Alfoots co, Korea) was used. Stabilizing ability of the plantar pressure is to resist gravity and maintain your body upright on the fixed ground. The posture stability of the archers in static condition was measured through their plantar pressure. As shown in <Figure 2>, to measure dynamic balancing ability in a shooting position, postures from anchoring to follow-through after shooting of the 2nd, 3rd internal respectively were measured for 2 seconds while each archer made 12 shots for the accuracy.

In terms of identifying the differences in test scores from before and after archer's participating in the upright body type exercise program, ENV(Envelope Area), REC(Rectangle), RMS(Root Mean Square), Total Length(Total Length from Cop), Sway velocity(Cop speed), Length/ENV were analyzed as for regulating measurement data. Also, matching sample paired t-test was conducted using SPSS 23.0 as for statistic processing and statistically significant level was set to be $\alpha=.05$.

RESULTS :

1. Difference test before and after the program on static balance of plantar pressure with the eyes opened

Difference test before and after the program on static balance of plantar pressure with the eyes opened resulted that every factor has no statistically significant difference ($\alpha=.05$).

2. Difference test before and after the program on static balance of plantar pressure with the eyes closed

As in <Table 2>, the difference test before and after the program on static stability analysis of plantar pressure with eyes closed resulted that every factor has statistically significant difference ($\alpha=.05$).

Table 2. Difference test before and after the program on static balance of plantar pressure with the eyes closed

Section	Before(n=10)	After(n=10)	t	p
	M±SD	M±SD		
ENV(mm ²)	65.22 ± 50.129	31.01 ± 18.502	2.449*	.037

REC(mm ²)	152.98 ± 138.517	55.54 ± 41.33	2.436*	.038
RMS(mm ²)	60.62 ± 67.234	21.69 ± 20.756	2.602*	.029
TLC(mm)	1125.86 ± 796.406	651.88 ± 316.284	2.689*	.025
Total Length(mm)	128.95 ± 41.336	89.29 ± 16.529	3.175*	.011
Sway velocity (mm/s)	6.44 ± 2.056	4.45 ± 0.826	3.206*	.011
Length/ENV (1/mm)	2.94 ± 1.15	2.297 ± 0.957	2.388*	.041

* $p < .05$, ** $p < .01$, *** $p < .001$

3. Difference test before and after the program on dynamic balance of plantar pressure in shooting

As in <Table 3>, the difference test before and after the program on static stability analysis of plantar pressure while shooting resulted that every factor has statistically significant difference ($\alpha = .05$).

Table 3. Difference test before and after the program on dynamic balance of plantar pressure in shooting

Section	Before(n=10)	After(n=10)	t	p
	M±SD	M±SD		
ENV(mm ²)	34.942 ± 13.727	24.81 ± 7.012	2.302*	.047
REC(mm ²)	155.898 ± 114.765	88.291 ± 36.526	2.430*	.038
RMS(mm ²)	113.346 ± 60.798	57.394 ± 29.744	3.087*	.013
TLC(mm)	173.472 ± 47.73	123.194 ± 35.632	3.772**	.004
Total Length(mm)	44.39 ± 16.207	32.088 ± 7.185	2.450*	.037
Sway velocity (mm/s)	22.699 ± 9.284	16.146 ± 4.006	2.276*	.049
Length/ENV (1/mm)	1.421 ± 0.115	1.332 ± 0.102	3.765**	.004

* $p < .05$, ** $p < .01$, *** $p < .001$

DISCUSSION : Some findings from the advanced research (Robert, 1989) reports that the body exercise improves the body balance while reducing postural sway, and giving the athletes' vision an advantage in balancing control by restriction and blocking of the visual condition. A study of Paulus, Straube & Brandt (1984) reports that little is the difference in body balance and postural sway with eyes opened while Horvat, Ramsey, Miszko, Keeney & Blasch (2003) say the body balance can be maintained primarily relying on visual feedback. Also, Gong (2005) reports that the body stabilizing exercise applied to healthy adults in their 20s remarkably increased the body balancing ability of the applicants compared to non-applicants. Okuda, Katayama & Senda (2005) reveal that the rate of postural sway appeared higher regardless of gender according to the findings from their study on visual feedback having their patients surveyed. Therefore, to sum up both the findings of the advanced studies and this study, the sway in body balance appears to reduce with eyes opened and it also appears that the athletes' vision has an advantage over body balance control. As the test results above indicate, the upright body exercise doesn't appear to affect the static balance of plantar pressure in the body sway with the archers' eyes opened while blocking of visual feedback appears to affect the static balancing ability as the sway of the body balance increases with the eyes closed, which means the upright body exercise proves effective for the static balancing of plantar pressure for the archers with the eyes closed. Since archers developed postural imbalance due to their specific exercising patterns that require them to partially use lower limbs and one-side of their body, it is

suggested that the upright body exercise program will improve the stability in body movement and static balance of planter pressure so that the efficiency in shooting will lead to better performances at games.

The findings from the advanced study of Son (2012) reveals that those who are a black-belt of Takwondo have significantly lower sway in terms of the dynamic balance of plantar pressure(standing on one leg after hurdling) compared to those are not.

Kim (2000) conducted a balancing training based on sprinter/skater pattern for 12 weeks onto 8 high school archers proved to affect the stability in body balance from anchoring to releasing in terms of factors like body pressure distribution and sway. According to Gong (2005), the body stabilizing exercise applied to healthy adults in their 20s remarkably increased the body balancing ability of the applicants compared to non-applicants

Archery is a sport that requires a series of coordination that is from supporting ability of lower limbs, to aiming & shooting along with the stability in spite of delicate dynamic movement in order to achieve better performances at games. Kim (1993) says there appears sway in body balance according to bow movement up and down in shooting, which demands more increased stability in body balance. As Kim (2008) mentions in his study that balancing training for archers helps reduce their body sway and results in their record improvement, even in this study the upright body exercise proved to be effective for the dynamic balance of plantar pressure while shooting, which means the stability of the dynamic balance of plantar pressure in shooting on a fixed supporting ground along with the coordination of upper and lower limbs becomes a very important factor for better performances. Thus, it is convincing that the upright body exercise program helps the dynamic balance of plantar pressure in shooting archery as it reduces the body sway.

CONCLUSION : The upright body exercise program appears to have a positive effect both on static and dynamic balance of plantar pressure with eyes closed as it reduces the body sway and increases stability in body balance. On the basis of these findings of this study, it is suggested that sports coaches or athletes can be benefited from utilizing this exercise program to help improve their athletic performances by achieving the postural correction, mind control, body alignment and stability in balance.

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Acknowledgement

This work was supported by the Brain Busan 21 Project in 2016.