HORIZONTAL BAR DISPLACEMENTS OF WOMEN WEIGHTLIFTERS DURING THE SNATCH

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The purpose of this study was to analyze the horizontal bar displacement of women weightlifters while performing the snatch. Thirty lifts performed at the 1999 United States National Weightlifting Championships were recorded and analyzed using a Peak5 2D Motion Analysis System. Three key displacement values were obtained for each lift: first pull, second pull, and just after peak height. The magnitude of bar displacement ranged from –3 to 8cm, for the first pull –14 to 14cm, for the second pull, and –3 to 21cm just after peak height is attained. Lifters did not display the horizontal displacement pattern that is described for men in the current literature.

KEY WORDS: weightlifting, snatch, female, bar trajectory, horizontal displacement

INTRODUCTION: Women have made great strides in weightlifting in recent years, most recently earning the right to complete in the 2000 Olympic Games. Although no single factor can determine success in weightlifting, many different kinematic variables have been examined (Kauhanen, Hakkinen, & Komi, 1984; and Burdett, 1982), to help coaches and researchers better understand the snatch and the clean and jerk. Although many biomechanical analyses have been conducted concerning the bar trajectory during the snatch, little research has been conducted using female subjects. The horizontal displacement of the barbell during the snatch is commonly used to assess the technique of the lifter. The barbells trajectory or horizontal displacement illustrates the weight of the lifter shifting between the balls and heels of the feet, and may be viewed as the degree of instability or degree of correction needed (Baumann, Volker, Quade, Galbirez, & Shwirtz, 1988; Garhammer, 1989a; and Garhammer, 1989b).
Garhammer (1985) identified three key position values for assessment of horizontal bar displacement during the snatch: 1) maximum horizontal movement distance of the bar away from the vertical starting point of the bar during the first pull, 2) maximum horizontal movement of the bar during the second pull, and 3) maximum horizontal movement of the bar immediately after peak height is attained at the end of the second pull. In all attempts that were analyzed, Garhammer (1985) discovered these values to be positive (towards the lifter) in the first pull, negative (away from the lifter) during the second pull, and again positive once the bar begins to ascend from peak height. Garhammer found displacement values to range from 3 to 9cm during the first pull, 3 to 18cm during the second pull, and 3 to 9 cm just after peak height was attained. Other research mirrors Garhammer's (1985) findings of a positive, negative, positive displacement pattern (Bauer & Isaac, 1987; Baumann, 1988; Garhammer, 1989a; and Garhammer, 1989b). Although an excessive horizontal displacement is detrimental to maximal force production, some is absolutely necessary to utilize the body's leverage systems to full advantage.

METHODS: The data for this study were collected at the 1999 USA Men's and Women's Weightlifting Championships held in St. Joseph, Missouri (USA). All female competitors at this national competition were video taped, but only the 69kg class (n=10) was analyzed. The 69kg class was considered one of the elite classes with the potential for setting the national record in this event. The camera was set to record at 60 fps, and it was placed perpendicular to the competitive platform and the lifter's sagittal plane. The performance of the 10 female lifters in the snatch were recorded and analyzed using a Peak5 2D Motion Analysis system. All attempts (successful and unsuccessful) were analyzed for each of the 10 lifters. Horizontal displacement values were obtained for the three key positions according to Garhammer (1985). Positive values represent movement of the bar towards the lifter, and negative values represent movement away from the lifter.

RESULTS AND DISCUSSION: The horizontal displacement values for 10 lifters performing 3 lifts each are listed in Table 1. The magnitude of initial horizontal bar displacement away from a vertical line representing the starting position of the barbell ranged from -3 to 8cm, with the average being 2cm. Displacement for the second pull ranged from -14(5 to -9cm for BO3) to 13cm(-1 to 12cm for HU1), with the average displacement being –1.5cm. Displacement of the bar immediately after peak height was attained ranged from -3(-1 to –4 for HA3) to 21cm(19 to 40 for HU2), with than average being 5.5cm. Less than half of the snatch attempts demonstrated the optimal towards, away, towards pattern described in the literature (Bauer & Isaac, 1987; Baumann, 1988; Garhammer, 1989a; and Garhammer, 1989b). Only six of the fourteen lifts displaying this pattern were successful. Although most of the individual attempts did not follow the optimal pattern, the average displacements did. This could possibly be due to those lifters with inconsistent or irregular bar displacements also having larger overall displacements. Large negative displacement values after peak height usually require the lifter to jump forward to catch the bar, and large positive values at this time usually require the lifter jump back for the catch.

Table 1 Horizontal Bar Displacements During the Snatch

			Horizontal Displacement (cm)		
Lifter	**Load** (kg)	**Successful**	**1st Pull**	**2nd Pull**	**Peak**
HA1	57.5	Y	-2	-7	5
HA2	62.5	N	-3	-6	12
HA3	62.5	N	1	-1	-3
OR1	72.5	N	2	-2	-1
OR2	72.5	Y	-1	-3	13
OR3	75	Y	3	2	4
RE1	65	N	3	-4	2
RE2	65	N	0	10	-16
RE3	65	Y	-1	-2	2
SI1	60	Y	2	8	3
SI2	65	Y	1	-2	17
SI3	70	N	-1	-2	6
BL1	75	Y	3	2	5
BL2	80	N	6	0	4
BL3	80	N	3	2	7
BO1	80	Y	6	-9	-3
BO2	82.5	Y	8	-12	3
BO3	85	N	5	-14	3
LE1	90	N	3	-6	7
LE2	90	N	3	-6	2
LE3	92.5	Y	2	-1	5
FO1	92.5	Y	5	-6	8
FO2	95	Y	1	-2	8
FO3	98	Y	-1	-2	6
HE1	92.5	N	1	-2	9
HE2	92.5	N	3	-7	3
HE3	92.5	Y	1	-6	8
HU1	92.5	N	-1	13	11
HU2	92.5	Y	5	14	21
HU3	95	Y	2	7	15

CONCLUSION: Most of the literature pertaining to optimal trajectories during the snatch has been conducted with skilled to elite male subjects. Although the female subjects analyzed in this study were also elite lifters, they display different horizontal displacement patterns. Garhammer (1985) stated that other individual factors such as segment lengths and muscle attachment points will dictate the optimal bar path. It is not yet known if these individual factors play an even greater role when trying to find optimal bar trajectories for women weightlifters. Further research is needed in this area to determine whether the present literature can be directly applied to women weightlifters. This limitation should be taken into consideration by coaches who are training female lifters for optimal technique. While it was previously stated that no single variable could predict success in weightlifting, a greater understanding of the factors that do make up a successful lift is the first step in understanding the snatch as a whole.

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