KINEMATIC COMPARISON OF OVERGRIP AND UNDERGRIP DISMOUNT GIANT SWINGS ON THE UNEVEN BARS

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INTRODUCTION AND PURPOSE: Uneven bar dismounts are executed from either overgrip or undergrip giant swings. Gymnasts performing either of these two styles of dismounts attempt to optimize release conditions and incorporate a beat swing associated with hip joint motion. The purpose of this study was to quantify projectile determinants, and swing and beat characteristics of the overgrip and undergrip dismount giant swings on the uneven bars (UB).

METHODS: Thirteen (seven undergrip and six overgrip) giant swings were recorded during the 1994 World Gymnastics Championships (Dortmund, Germany) with 2 video cameras operating at 50 Hz. They were analyzed utilizing the Ariel Performance Analysis System (APAS). Three dimensional position data of 12 body points (ankles, knees, hips, shoulders, elbows, and hands) and a point on the top bar were calculated by combining the video images of the two cameras utilizing the direct linear transformation (DLT) method (Abdel-Aziz & Karara, 1971). The raw data was digitally smoothed with a cut-off frequency of 5 Hz before being submitted to further analysis. Dempster's (1955) data as presented by Plagenhoef (1971) was utilized to predict the segmental and total body anthropometric parameters necessary to solve the mechanical equations.

RESULTS AND DISCUSSION: Table 1 presents beat swing characteristics for the undergrip and overgrip dismount giant swings studied. It should be noted that in the present study, contrary to definitions by Cheetham (1984) and Gervais & Tally (1993), where beat referred to the hip joint flexion seen prior to high bar release, beat swing refers to a rapid hip joint extension which proceeds the described hip joint flexion. The main purpose of this rapid extension is to stretch the hip joint flexors, which in turn permits a more powerful hip joint flexion during the upswing. The range of motion of hip joint extension vs. hip joint flexion is approximately the same in overgrip dismount giant swings. In undergrip giants, the beat is delayed by almost a quadrant, and the hip joint flexion begins near the end of the upswing, prior to bar release. In either giant, the ultimate purpose of these motions is to optimize projectile determinants and release angular momentum. The results in Table 1 confirm that hip joint extension (which initiates the beat) begins earlier in the overgrip dismount giants (1st vs. 2nd quadrant). Hip joint maximum extension was reached just prior to the bottom of the swing in the overgrip dismount giants, as opposed to the third quadrant, close to release, in the undergrip. In addition to timing, the two beat swings also differ significantly in magnitude, with the undergrip giant beat exhibiting almost twice as much hip joint range of motion (ROM) as the overgrip (111 vs. 65 degrees, respectively). The duration of the beat

Table 1
Beat Swing Characteristics M (SD)

Variable	Undergrip (n=7)		Overgrip (n=6)		*t*-score	*p*
Body position at min. hip joint angle(deg)	134	(10.6)	78	(13.9)	8.2	.002
Body position at max. hip joint angle(deg)	234	(7.3)	166	(13.1)	11.8	<.000
Min. hip joint angle (deg)	107	(5.7)	138	(19.8)	- 4	.002
Max. hip joint angle (deg)	218	(10.9)	203	(11.5)	2.3	.04
Body ROM (deg)	100	(14.2)	88	(3.6)	3.6	n/s
Hip joint ROM (deg)	111	(14.4)	65	(16.5)	5.4	<.000
Duration of beat (sec)	.39	(.06)	.31	(.1)	1.8	n/s

n/s: non-significant

swing and the body ROM were greater in the undergrip dismount giant, but the differences were not significant (0.39 vs. 0.31 sec; 100 vs. 88 deg for undergrip and overgrip dismount giant swings, respectively).
There were no significant differences between overgrip and undergrip dismount giant swings in terms of center of mass (CM) release angular velocity

Table 2
Mechanical Variables at Release M (SD)

Variable	Undergrip (n=7)		Overgrip (n=6)		*t*-score	*p*
CM horizontal velocity (m/sec)	1.02	(.30)	1.14	(.37)	-.7	n/s
CM vertical velocity (m/sec)	3.6	(.62)	3.2	.62	1.3	n/s
Radius of gyration (% of height)	51.6	(2.3)	58.8	(7.6)	-2.4	.03
Angular velocity (rad/sec)	5.27	(.82)	4.82	(.98)	.92	n/s
Shoulder joint angle (deg)	188	(9.1)	135	(18.5)	6.8	<.000
Hip joint angle (deg)	191	(23)	140	(23.9)	3.9	.002
Knee joint angle (deg)	122	(18)	140	(32.2)	-1.3	n/s
Body position (deg)	-6	(8.7)	-2.5	(7.3)	-.77	n/s

n/s: non-significant

(5.27 vs. 4.82 rad/sec for undergrip and overgrip dismount giants, respectively), CM position (both released the bar when the CM was below the bar), and CM horizontal and vertical release velocities (Table 2). CM horizontal release velocity was similar to the corresponding velocities for various types of high bar (HB) dismounts reported previously by Brüggemann Cheetham, Alp & Arampatzis (1994), Park & Prassas (1994), Kerwin, Yeadon & Harwood (1993) and Takei, Nohara & Kamimura (1992). CM vertical release velocity (3.2/3.6 m/s for overgrip and undergrip giant swing dismounts, respectively) was substantially smaller than vertical velocities reported by Brüggemann et al. (1994), Park and Prassas (1994) and Takei et al. (1992) for various types of HB dismounts (4.04 to 5.98 m/s). In a previous study by Prassas (1996), UB CM horizontal release velocities were slightly larger than the values observed in the present one (1.02-1.14 vs. 1.33 m/s for present/previous values, respectively). Vertical release velocities were similar in the two UB studies (3.2-3.6 vs. 3.1 m/s for present/previous values, respectively). Radii of gyration (defined as the CM distances from the bar) at release, reflecting body configuration, were significantly different between the two dismount giant swings (51.6 vs. 58.8 % of height for undergrip and overgrip giants, respectively). This differences in the radii of gyration are contradictory to shoulder and hip joint angle data, which revealed that the gymnasts were more extended at the hip and shoulder joints at release in the undergrip giant dismounts. A more pronounced knee joint flexion in the undergrip dismounts could have explained this contradiction, but the results (140 vs. 122 knee joint angle for overgrip and undergrip giant swing dismounts, respectively) do not support this argument.

CONCLUSION: Results indicate that overgrip and undergrip giant swings generated similar projectile determinants for uneven bars dismounts. There were, however, significant differences between the two swings in the timing and magnitude of the hip joint beat action which partially generates the projectile determinants. Further study is needed to explain the apparent contradictions in the relationship between the radius of gyration and joint angles at release.

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