Wrist-hinge Angle and Velocity in Golfers of Varying Proficiency

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Mathematical modeling has shown that wrist-hinge angle (WH) and wrist-hinge angular velocity (WHV) prior to impact in the golf swing are important contributors to ball velocity. While, golf professionals appreciate the importance of WH for increasing ball velocity and subsequently driving distance, the relationship between WH and ball velocity has not been established in actual golfers.

PURPOSE: To demonstrate that those golfers with greater ball velocity will have greater WH and faster WHV during the downswing compared to golfers with slower ball velocity. **METHODS**: 109 male right handed golfers (age: 44 ± 14 years, USGA handicap: 6.8 ± 5.6) underwent a swing analysis using their driver. Swing mechanics were assessed using an 8-camera high speed 3D optical motion analysis system (200 Hz). WH was calculated as the angle between the club and the lead arm, and WHV was the derivative of WH. Golfers were divided into 3 equal groups, low (L), medium (M), and high (H), according to their ball velocity measured with a golf launch monitor. For determining the group differences, a one-way analysis of variance (ANOVA) was performed for each variable at top of swing (Top), lead-arm parallel (LAP), 40ms prior to impact (L40), impact (Im), and maximum (Max) value during the downswing. Subsequently, a Bonferroni correction was used to identify the group differences. Statistical significance was set *a priori* at $p<0.05$.

RESULTS: Mean ball velocity was significantly different for each group (L: 128.7± 4.3, M: 143.4±4.6, and H: 159.1±6.4 mph, $p<0.001$). No differences were observed between groups for WH or WHV at Top. The significant group differences are presented in Table 1.

Table 1: Significant differences between groups

Variable	Groups	Mean ± StDev	p value
WH-LAP (°)	L vs. M	61.5 ± 17.0 vs. 72.6 ± 15.1	0.008
	L vs. H	61.5 ± 17.0 vs. 76.2 ± 12.6	<0.001
WH-L40 (°)	L vs. M	30.3 ± 9.4 vs. 39.2 ± 9.7	0.001
	M vs. H	39.2 ± 9.7 vs. 46.9 ± 10.4	0.003
	L vs. H	30.3 ± 9.4 vs. 46.9 ± 10.4	<0.001
WHV-L40 (°/s)	L vs. M	-667.1 ± 141.3 vs. -785.9 ± 146.5	0.003
	L vs. H	-667.1 ± 141.3 vs. -836.1 ± 142.4	<0.001
WHV-Im (°/s)	L vs. H	51.6 ± 451.3 vs. -255.9 ± 392.2	0.006
	M vs. H	29.7 ± 379.6 vs. -255.9 ± 392.2	0.010
WHV-Max (°/s)	L vs. M	-709.0 ± 147.5 vs. -837.4 ± 134.1	0.002
	L vs. H	-709.0 ± 147.5 vs. -947.2 ± 163.5	<0.001
	M vs. H	-837.4 ± 134.1 vs. -947.2 ± 163.5	0.006

CONCLUSION: Given no differences at Top and differences in WH and WHV during the downswing, golfers with greater ball velocity retained their WH longer and generated more WHV before impact, generating more ball velocity. This supports both the mathematical and anecdotal evidence. Furthermore, the timing of WH release to achieve maximal WHV may be critical for greater ball velocity.