RELATIONSHIP BETWEEN ISOMETRIC MID-THIGH PULL KINETICS AND DRIVER CLUB HEAD SPEED IN DIVISION II GOLFERS

John C. Garner[1], Jeffrey D. Simpson[2], Kyle B. Rank[2], & Tolver Dozier[3]
[1]Department of Kinesiology & Health Promotion, Troy University, Troy, AL, USA
[2]Department of Movement Sciences & Health, University of West Florida, Pensacola, FL, USA
[3]Tolver Dozier Golf, Troy, AL, USA
Email: jcgarner@troy.edu

Introduction

Within the realm of golf science, the specificity of force generation and the relationship to club head speed (CHS) capability has been frequently investigated. Past studies have identified that performance on both field (e.g. countermovement jump) and gym-based tests (e.g. strength) are correlated with CHS; however, the general extrapolation of data from these tests to predict CHS may be overstated given the movement strategies and specific time components of the respective movements are not considered. Recently, positive relationships between force generation capability and CHS during an isometric mid-thigh pull (IMTP) have been reported in golfers. The IMTP is a reliable and valid test to obtain both magnitude of force and rate of force development (RFD) that may be reflective of the force generation capabilities during the golf swing, but studies have not yet identified the contributions from the lead and trail legs and their relationship to CHS. Given that the golf swing requires the use of both lead and trail legs, identifying leg-specific contributions will further our understanding on the utilization of appropriate tests that more accurately predict CHS. The purpose of this study was two-fold: 1) to determine differences in force generation capability during an IMTP between the lead and trail legs, and 2) identify force generation predictors of CHS from an IMTP test.

Methods

Eighteen Division II golfers (male=10; female=8; age: 20±1 y; height: 171.4±4.7 cm; mass: 69.7±17.5 kg; experience: 11±5 y; personal best round: 66±2 strokes) volunteered and completed the study. Participants completed a total 10 stock swings on a FlightScope Mevo+ in an indoor environment with their driver. On a separate day, 3 trials of a 5 second isometric mid-thigh pull (IMTP) with a barbell was completed on a dual-force platform system sampling at 1000 Hz. Vertical ground reaction force (GRF) data from the force platform was used to identify peak vertical GRF and rate of force development (RFD) at 50, 100, 150, and 200 milliseconds (ms) during the IMTP trials from both the lead and trail legs. Cumulative averages from the 3 IMTP trials were computed and the average of the 5 highest CHS from driver were used in the analysis. A stepwise regression model using backward elimination was computed to identify significant predictors of CHS. Furthermore, dependent variables from the IMTP were also compared between the lead and trail legs using a dependent samples t-test ($p<0.05$) and the magnitude of differences were evaluated using Cohen's D effect sizes.

Results and Discussion

Average CHS from the sample for driver was 105.5±11.9 mph. The trail leg generated significantly greater peak vertical GRF ($p=0.023$; ES=0.40), RFD at 150 ($p=0.004$; ES=0.004), and RFD at 200 ($p<0.001$; ES=0.039) compared to the lead leg. The stepwise regression model identified 5 variables that were significant predictors of driver CHS: (1) trail leg RFD at 50 ms ($p=0.001$; $r=0.646$), (2) lead leg RFD at 50 ms ($p<0.001$; $r=0.514$), (3) trail leg RFD at 100 ms ($p=0.014$; $r=0.650$), (4) lead leg RFD at 100 ms ($p=0.006$; $r=0.514$), and (5) trail leg RFD at 200 ms ($p<0.001$; $r=0.739$). These variables explained a combined 88% of the variance in driver CHS. Greater peak vertical force and RFD at 150 and 200 ms suggests that the lead and trail legs exhibit significantly different force generation capabilities during an IMTP. While the differences between lead and trail legs could be the result of many factors, both lead and trail leg RFD at 50 and 100 ms appear to be significant predictors of CHS.

Significance

Past studies have identified that the downswing occurs within 280 ms with impact occurring around 100-150 ms. The first 100 ms of the IMTP resulted in equal contribution of both the lead and trail leg and RFD during this time window were identified to be significant predictors of CHS. Based on our data, implementing programs that emphasize rapid force generation could be beneficial to increasing CHS rather than the magnitude of force generation alone. It may be worth examining other functional tests in the time domain to further strengthen the predictability of CHS. This would help identify specific parameters to more accurately predict a golfers CHS potential that are reflective of the temporal characteristics of the golf swing.

Descriptive data from the IMTP (mean±SD)

	Peak GRF	**RFD 50**	**RFD 100**	**RFD 150**	**RFD 200**
Lead Leg	424.6±165.1	2472.1±1833.5	1964.2±1080.7	1230.4±671.8	977.9±610.6
Trail Leg	488.5±153.9	2281.1±1400.1	2067.4±1070.4	1446.4±789.1	1243.7±755.1
P value	0.023	0.305	0.326	0.004	0.001
ES	0.40	0.12	0.10	0.30	0.39

Stepwise linear regression model summary:	**R**	**R^2**	**Adj.R^2**	**SEE**	**p value**
Club Head Speed (mph) = 78.5 + (0.26)TL50 – (0.23)LL50 – (0.22)TL100 + (0.23)LL100 + (0.21) TL200	0.938	0.88	0.830	4.92	0.010