

# **Commercial golf glove effects on golf performance and forearm muscle activity**

Graeme G. Sorbie, Paul Darroch, Fergal M. Grace,  
Yaodong Gu, Julien S. Baker and Ukadike C. Ugbolue

This is an Accepted Manuscript of an article published by Taylor & Francis in Research in Sports Medicine: an International Journal on 18th August 2017, available online: <http://dx.doi.org/10.1080/15438627.2017.1365291>

1 Research in Sport Medicine – GSPM-2016-0149.R1

2 Accepted: 5<sup>th</sup> April

# 3 **Commercial golf glove effects on golf performance** 4 **and forearm muscle activity**

5 <sup>1,2</sup>Graeme G. Sorbie; <sup>1</sup>Paul Darroch; <sup>1,3</sup>Fergal M. Grace; <sup>4</sup>Yaodong Gu; <sup>1</sup>Julien S. Baker and <sup>1,5</sup>Ukadike  
6 C. Ugbolue

7

8 <sup>1</sup> School of Science and Sport, Institute for Clinical Exercise & Health Science, University of the West  
9 of Scotland, Hamilton, ML3 0JB, United Kingdom;

10 <sup>2</sup> Division of Sport and Exercise Sciences, Abertay University, Dundee, DD1 1HG, United Kingdom

11 <sup>3</sup>Faculty of Faculty of Health, Human Movement and Sport Sciences, Federation University Australia,  
12 Ballarat, Victoria, Australia;

13 <sup>4</sup>Faculty of Sports Science, Ningbo University, China;

14 <sup>5</sup>Department of Biomedical Engineering, University of Strathclyde, Glasgow, United Kingdom

## **Corresponding author**

Ukadike Chris Ugbolue

Biomechanics Laboratory

15 School of Science and Sport,

16 Institute for Clinical Exercise & Health Science,

17 University of the West of Scotland,

18 Hamilton, ML3 0JB,

19 United Kingdom

Phone: +44 (0)1698 283100 Ext 8284

Email: [u.ugbolue@uws.ac.uk](mailto:u.ugbolue@uws.ac.uk);

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22 **Abstract**

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1 **Purpose** To determine whether or not commercial golf gloves influence performance variables and  
2 forearm muscle activity during golf play. **Methods** Fifteen golfers participated in the laboratory  
3 based study, each performing 8 golf swings with a Driver and 7-iron whilst wearing a glove and 8  
4 without wearing the glove. Club head speed, ball speed and absolute carry distance performance  
5 variables were calculated. Surface electromyography was recorded from the flexor digitorum  
6 superficialis and extensor carpi radialis brevis on both forearm muscles. **Results** Club head speed,  
7 ball speed and absolute carry distance was significantly higher when using the Driver with the glove  
8 in comparison to the Driver without the glove ( $p < 0.05$ ). No significant differences were evident  
9 when using the 7-iron and no significant differences were displayed in muscle activity in either of the  
10 conditions. **Conclusion** Findings from this study suggest that driving performance is improved when  
11 wearing a glove.

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13 **Keywords: Club Head Speed, Ball Speed, EMG, ECRB, FDS**

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16 **Word Count: 4214**

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27 **Introduction**

1 Golf has become an increasingly popular sport for players of differing ages and skill levels (Farrally et  
2 al., 2003). A golfer's prime objective is to finish a golf round using minimum shots. Several key  
3 factors for improving golf performance have been previously identified; including improving physical  
4 characteristics through golf training programmes (Lephart, Smoliga, Myers, Sell, & Tsai, 2007) and  
5 coaching to improve swing mechanics (Hume, Keogh, & Reid, 2005). In addition, golfers will also  
6 change equipment in an attempt to improve performance, which is also common amongst other  
7 sports (Stefanyshyn & Wannop, 2015).

8 Commercial golf gloves are not a required piece of equipment when playing golf but are often used  
9 by golfers to assist perceived level of performance. Leading manufacturers claim that the golf glove  
10 helps to create friction between the hand and golf grip when holding the club, thus potentially  
11 increasing the performance of the golfer. However, to our knowledge, there is no published research  
12 to support these performance enhancement claims. The friction created between the fingers/palm  
13 of the hand and different types of sports equipment can often influence how well the athletes are  
14 able to perform (Lewis et al., 2014). The friction generated not only controls how well different  
15 objects can be gripped, but also how the equipment feels to the athlete and what the perceived  
16 level of performance is (Lewis et al., 2014). For example, during wheelchair rugby the use of gloves is  
17 promoted to increase the friction between the hand and wheelchair. Lutgendorf et al. (2009)  
18 showed that the use of an NFL glove significantly increased acceleration and agility compared to  
19 various other gloves and therefore increased performance of the athlete. It was found that,  
20 acceleration and agility were also reduced when athletes did not wear a glove (bare hand).

21 A key component in improving golf performance is being able to increase the distance and accuracy  
22 of the golf shot within the long game. Fundamentals to this are club head speed (CHS), ball speed  
23 (BS) and club face angle at impact (Fradkin, Sherman, & Finch, 2004). Egret et al. (2003) reported a  
24 CHS of 161 km/h whilst using a Driver and Sorbie et al. (2016) reported CHS of 126 km/h when using  
25 a 7-iron, thus clearly showing distinct differences between longer and shorter golf clubs. Due to

1 these high levels of CHS, a significant force from the forearm is required in order to allow the golfer  
2 to maintain grip throughout the golf swing (Komi, Roberts, & Rothberg, 2008).

3 Previous research has reported high levels of forearm muscle activity from the flexor and extensor  
4 muscles during the golf swing using the electromyography (EMG) technique. Farber et al. (2009)  
5 reported levels of up to 74% of maximum voluntary contraction (MVC) during the forward swing  
6 phase, and up to 128% of MVC during the acceleration phase when examining the extensor carpi  
7 radialis brevis (ECRB) muscle whilst using the golf Driver. Sorbie et al. (2016) reported somewhat  
8 lower levels of muscle activity from the flexor digitorum superficialis (FDS) (89.3%) and ECRB (87.8%)  
9 muscles of the forearm during the golf swing, however, these swings were performed using the 7-  
10 iron.

11 Several industrial studies have used EMG to assess forearm muscle activity when using gloves  
12 (Kovacs, Splittstoesser, Maronitis, & Marras, 2002; Larivière et al., 2004). Although these studies are  
13 not directly comparable to the golf swing, Larivière et al. (2004) reported changes in ECRB and FDS  
14 forearm muscle activation levels when performing handgrip tests with a glove compared to the bare  
15 hand (15% increase on average). Kovacs et al. (2002) also reported an increase in EMG forearm  
16 muscle activation levels when comparing the bare hand grip to several different glove materials. A  
17 biomechanical assessment using EMG could provide important information on the loading of the  
18 forearm muscles during the golf swing when using the golf glove compared to using the bare hand.  
19 Specifically, a reduction on the load placed on the forearm muscles may help prevent injuries to the  
20 elbow area (Dickerson, Martin, & Chaffin, 2007). Lateral and medial epicondylitis are two of the main  
21 elbow symptoms associated with golfers, especially golfers within the amateur category (Farber et  
22 al., 2009; Glazebrook, Curwin, Mohammad, Kozey, & William, 1994).

23 When considering the previously reported performance and muscle activity changes when using  
24 gloves in industrial work and specific sporting events, it was reasonable to hypothesise that  
25 performance variables and muscle activity may change during the golf swing when wearing a glove

1 compared to the bare hand. Furthermore, with the significant changes in CHS between the Driver  
2 and iron clubs, an assessment between these clubs is also required when using the commercial golf  
3 glove. Thus, the purpose of the present study was to determine how a commercial golf glove  
4 influences performance CHS, BS and Absolute Carry Distance (ACD) and forearm muscle activity  
5 during a golf swing whilst using the Driver and the 7-iron.

## 6 **Methods**

### 7 **Participants**

8 After obtaining ethical approval from the university ethics committee, fifteen right-handed male  
9 golfers participated in this laboratory based study (height:  $183.7 \pm 7.3$  cm, weight:  $77.6 \pm 9.8$  kg, age:  
10  $24.3 \pm 4.0$  years, handicap:  $18.0 \pm 5.6$ , effect size  $< 0.5$ ;  $\alpha$  err prob = 0.05, Power = 80%). All  
11 participants were free from injury. Participants were also required to have no elbow or wrist injuries  
12 in the past year and no surgery in the identified areas in the past five years. The researchers  
13 explained the procedures and purpose of the study to all participants. All participants completed a  
14 physical readiness questionnaire and consent form prior to participation in the study.

### 15 **Apparatus**

16 The experimental set-up included: an artificial golf mat placed in the centre of the laboratory; an  
17 enclosed golf net (Sports Net Company, United Kingdom) located 2 m from the golf mat (Longridge,  
18 United Kingdom); an 8 camera Vicon Bonita (Oxford Metrics Ltd, United Kingdom) Motion Analysis  
19 System operating at 250 Hz positioned at strategic positions around the golfer; a set of 8 EMG  
20 Transmitters operating at 1000 Hz and filtered at 10-500 Hz (Myon 320, Schwarzenberg, Switzerland)  
21 in conjunction with Surface Electrodes (AMBU, Cambridgeshire, UK) used to measure muscle  
22 activity. A Digital Handheld Dynamometer (Medical research, Leeds, UK) was used to measure  
23 Maximal Voluntary Contractions (MVC). The EMG system was synchronised in conjunction with the  
24 Vicon Bonita Motion Analysis System to facilitate simultaneous data collection. The Voice Caddie

1 Swing Launch Monitor SC 100 GPS (La Mirada, CA, USA) was used to calculate CHS, BS and ACD of  
2 each golf shot. The Launch Monitor was previously validated in-house against the Vicon Bonita  
3 Motion Analysis System; Trackman™ III Golf Swing and Ball Flight Analysis System (Brighton, MI,  
4 USA).

5 For the golf shots, a Taylormade (Basingstoke, UK) Speed Blade Stiff Shaft 7-iron, with a shaft length  
6 of 37 inches and a Taylormade SLDR Stiff Shaft Driver, with a shaft length of 45.5 inches were used.  
7 Titleist Pro-V1 (Titleist, Cambridgeshire, UK) golf balls were also used for all golf shots. Each of the  
8 clubs had 4 retro-reflective markers attached to them; this enabled the determination of the five  
9 phases of the golf swing using the Nexus 2 Vicon Data Capture Software. These markers were placed  
10 on the base of the grip, halfway down the club, the hosel of the club, and the club head (Higdon,  
11 Finch, Leib, & Dugan, 2012). To enable the analysis of the golf swing, researchers often divide the  
12 golf swing into the five phases that are detailed in Figure 2 (Farber et al., 2009; Lim, Chow, & Chae,  
13 2012; Marta, Silva, Vaz, Bruno, & Pezarat-correia, 2013; Marta, Silva, Vaz, Castro, & Pezarat-correia,  
14 2015; Sorbie et al., 2016). Taylormade ST (Taylormade, Basingstoke, UK) synthetic gloves were used  
15 as part of the experiment. Small, medium, medium/large, large, and extra-large groves were  
16 available to participants. The glove was required to fit comfortably across the palm and finger  
17 regions of the hand.

## 18 **Electromyography Procedure**

19 In order to reduce the impedance of the interface between the skin and electrode, the skin was  
20 prepared by removing hair from the forearm, alcohol cleaned and abraded for electrical  
21 connectivity. The electrodes were then placed on the ECRB and FDS forearm muscles on the left and  
22 right arms (Figure 1). To standardise the placement of the electrodes of the ECRB muscle a line was  
23 marked between the lateral epicondyle and the radial styloid process. The ECRB is located in the  
24 proximal half of the forearm, just lateral to the line (Basmajian, 1989). The electrode for the FDS

1 muscle was placed towards the middle of the forearm, halfway from the ventral midline to the  
2 medial border of the forearm (Blackwell, Kornatz, & Heath, 1999).

3 Following the EMG electrodes being secured and the signals verified, participants performed two 3 s  
4 maximum isometric handgrip contractions in maximum flexion for the FDS reference. Participants  
5 then performed two 3 s maximum isometric handgrip contractions in maximum extension for the  
6 ECRB reference. Specifically, participants were instructed to slowly increase the force and be at  
7 maximum effort after 3-5 s, and hold the maximum force for a further 3 s. Participants were given 5  
8 minutes recovery time between each contraction. During the contractions, the forearm was secured  
9 in a previously validated rig in order to minimize elbow and shoulder movement. The rig held the  
10 elbow at approximately 120° during the handgrip recordings. The mean of 500 ms at the highest  
11 signal portion of the MVC was examined in order to normalize the golf swing (Konrad, 2006). The  
12 activity patterns of the golf swing were assessed every 20 ms and expressed as a percentage of MVC  
13 (Farber et al. 2009).

#### 14 **Experimental Design**

15 Prior to collecting golf swing data, participants were asked to perform a dynamic warm-up routine  
16 targeting the full body. After the warm-up routine was complete the participants performed several  
17 golf shots. The testing process comprised:

- 18 • 8 shots with the Driver using the glove (G)
- 19 • 8 shots with the Driver without using the glove (NG)
- 20 • 8 shots with the 7-iron using the glove (G)
- 21 • 8 shots with the 7-iron without using the glove (NG)

22 All golf shots in the session were hit at a rate of one shot every 30 s. During a pilot study, golfers  
23 stated that this was a comfortable pace to perform the golf shots. Between each of the conditions  
24 participants rested for 2 minutes to avoid muscular fatigue of the forearm. The participants were



1 asked to aim towards a red target pole which was situated behind the golf net and advised to take  
2 into consideration the accuracy and distance of their normal Driver and 7-iron shots. The order of  
3 this process was randomised using a processing generator (TextFixer: [www.testfixer.com](http://www.testfixer.com)). This  
4 minimised any systematic error in testing. During each of the golf shots that were performed, video,  
5 EMG and performance data was recorded.

## 6 **Data Analysis**

7 For the performance variables and EMG data, mean values were calculated for 8 golf shots  
8 performed by each participant during each of the 4 conditions. Following this, mean values were  
9 calculated across participants. Normal distribution for all variables was assessed using the Shapiro-  
10 Wilk test (McCormick et al. 2014). A null hypothesis for the tests was accepted due to all  $p$  values  
11 being higher than 0.05. Upon this being determined a two-way repeated measures ANOVA was used  
12 to identify differences in EMG data sets when using the golf glove compared to not using the golf  
13 glove (bare hand), during the five phases of the golf swing (Farber et al., 2009; Lim et al., 2012;  
14 Marta et al., 2013, 2015; Sorbie et al., 2016). Muscle activity was expressed as a percentage of the  
15 MVC. All performance variables were analysed for statistical significance using a paired t-test.  
16 Additionally, all calculations were performed on SPSS (version 22) and Microsoft Excel (version  
17 2010), and  $p < 0.05$  was considered significant.

## 18 **Results**

### 19 **Performance**

#### 20 **Driver**

21 Participants displayed significantly higher CHS with the Driver G ( $150.76 \text{ km/h} \pm 7.63$ ) in comparison  
22 to the Driver NG ( $146.93 \text{ km/h} \pm 9.56$ ) ( $p = 0.025$ ) (Figure 3). Participants displayed significantly  
23 higher BS with the Driver G ( $218.57 \text{ km/h} \pm 15.39$ ) in comparison to the Driver NG ( $212.49 \text{ km/h} \pm$

1 16.21) ( $p = 0.030$ ) (Figure 4). The ACD was also significantly increased when comparing the Driver G  
2 (204.41 M  $\pm$  28.83) to the Driver NG (193.50 M  $\pm$  27.28) ( $p = 0.012$ ).

### 3 **7-iron**

4 Participants displayed no significant differences in CHS whilst using the 7 Iron G (130.83 km/h  $\pm$  9.74)  
5 in comparison to the 7-iron NG (128.25 km/h  $\pm$  9.31) ( $p = 0.151$ ) (Figure 3). No significant differences  
6 were displayed in BS when comparing the 7-iron G (167.07 km/h  $\pm$  17.14) to the 7-iron NG (162.58  
7 km/h  $\pm$  18.44) ( $p = 0.068$ ) (Figure 4). No significant differences were displayed between the ACD  
8 when comparing the 7-iron G (127.90 m  $\pm$  18.88) to the 7-iron NG (122.83 m  $\pm$  18.30) ( $p = 0.059$ ).

### 9 **Muscle Activity**

#### 10 **Comparison between Conditions (Glove vs No Glove)**

11 All participants displayed a similar trend in forearm muscle activity pattern when comparing the use  
12 of the glove and the bare hand whilst using the Driver and 7-iron. The muscle activity for the FDS and  
13 ECRB in the lead (left hand for right handed golfers) and trail (right hand for right handed golfers)  
14 arm for the five phases of the golf swing are displayed on Table 1. No significant differences were  
15 displayed in the FDS and ECRB muscle activity in the lead or trail arms during the five phases of the  
16 golf swing when comparing the use of the commercial golf glove and the bare hand (all  $p > 0.05$ ).

#### 17 **Comparison between Phases**

18 The FDS and ECRB forearm muscles on the lead and trail sides displayed peak activation values  
19 during the forward swing, acceleration and early follow-through phases (Table 1). All muscles  
20 showed significant statistical differences between the peak activation (forward swing, acceleration  
21 and early follow-through) phases compared to the lower activation phases (backswing and late  
22 follow-through) (all  $p < 0.05$ ).

23

1 **Discussion**

2 The aim of the present study was to determine how a commercial golf glove influences CHS, BS and  
3 ACD when performing golf shots with the Driver and 7-iron. Secondly, the study aimed to investigate  
4 the muscle activation levels from the forearm muscles when using the golf glove compared to the  
5 bare hand whilst using the Driver and the 7-iron at the five phases of the golf swing.

6 The present study is in agreement with previously published research where performance in sports  
7 has been shown to improve with the use of a glove (Lewis et al., 2014; Lutgendorf et al., 2009). With  
8 similar results to the present study, where the researchers displayed a significant increase in CHS  
9 and BS, Lutgendorf et al. (2009) showed that the use of a glove in wheelchair rugby significantly  
10 increased acceleration compared to the bare hand. In addition to this, during ultimate frisbee, Lewis  
11 et al. (2014) reported that using a glove when catching the frisbee increased friction and, therefore,  
12 increased performance during the execution of the skill. The results of the present study also  
13 support the claim made by leading golf manufacturers that the commercial golf glove increases  
14 friction between the hand and the golf grip and, therefore, could have a positive impact on golf  
15 swing performance (Golfsmith, 2016). However, the result of the present study only displays this  
16 change to be significant when using the Driver and not the 7-iron. It could be suggested that the  
17 contrasting results between the Driver and 7-iron could be due to the Driver generating a  
18 significantly higher CHS when compared to the 7-iron ( $p < 0.05$ ). These changes may also be a result  
19 of the forearm muscles generating marginally higher activation levels when using the Driver  
20 compared to the 7-iron, which supports previously published literature (Farber et al., 2009;  
21 Glazebrook et al., 1994; Sorbie et al., 2016). The contrasting results could also be due to the Driver  
22 having a longer shaft length compared to the 7-iron and the two clubs being used for different shots  
23 in the golf game. The Driver is used to hit the ball as far as possible (Nagao & Sawada, 1973),  
24 whereas the 7-iron club is mainly used for shots between 100 m – 150 m where high accuracy and  
25 precision is essential (Egret et al., 2003).

1 With regards to forearm muscle activity, the present study is somewhat contrasting to other  
2 published research. Larivière et al. (2004) and Kovacs et al. (2002) reported an increase in forearm  
3 muscle activation levels during a handgrip test when wearing a glove compared to the bare hand. In  
4 contrast, the present study shows that there is no significant change in forearm muscle activity when  
5 wearing the golf glove compared to not wearing the golf glove whilst using the Driver or 7-iron.  
6 These contrasting findings may be a result of the high variability of the muscle activation levels or  
7 due to the static components of the handgrip test and the dynamic movement of the golf swing.  
8 With no increased load placed on the forearm muscles when comparing the commercial golf glove  
9 to the bare hand during the golf swing, it could be suggested that using the golf glove does not  
10 reduce the risk of injury to the elbow (Dickerson et al., 2007). Previous studies have shown that  
11 increased forearm muscle activity may increase the risk of medial and lateral epicondylitis when  
12 performing the golf swing (Farber et al., 2009; Glazebrook et al., 1994).

13 With reference to the five phases of the golf swing, the present study displays distinct differences in  
14 forearm muscle activation between the five phases. The results from the present study show that in  
15 most cases the lead and trail forearm muscles are more active during the forward swing,  
16 acceleration and early follow-through phases compared to the backswing and late follow-through  
17 phases. These findings are in agreement with Farber et al. (2009) and Sorbie et al. (2016) where these  
18 researchers displayed a similar trend when examining forearm muscle activity when using the Driver  
19 and 7-iron clubs respectively. Specifically, Farber et al. (2009) showed that the ECRB muscle on the  
20 lead arm increased progressively between the backswing (21.3% EMG), forward swing (74.2% MVC)  
21 and acceleration (94.2% EMG) phases when examining amateur golfers. Additionally, muscle activity  
22 then progressively reduced between the acceleration (94.2% EMG), early follow-through (32.1%  
23 EMG) and late follow-through (31.1% EMG) phases of the golf swing. With regards to the muscle  
24 activation values of the ECRB muscle, Farber et al. (2009) displayed higher values during the forward  
25 swing, acceleration and late follow-through phases compared to the current study. These changes  
26 may be a result of the higher mean handicap (18.0 mean handicap) in the current study compared

1 the study by Farber et al. (2009) (15.1 mean handicap). However, these changes may also be a result  
2 of different methodologies used between the two studies. Farber et al. (2009) used fine-wire EMG to  
3 collect muscle activity from the forearm muscles whereas the present study used surface EMG.

4 The researchers acknowledge that there are some limitations to the present study. Firstly, it must be  
5 considered that EMG signal crosstalk from surrounding extensor and flexor muscles is a limitation to  
6 the current study. The following steps were taken to reduce EMG signal cross-talk between muscles.  
7 The surface electrodes were positioned within the middle of the muscle belly of the FDS and ECRB  
8 forearm muscles and applied in parallel arrangement to the muscle fibres, with a centre to centre  
9 inter-electrode distance of 2 cm. Secondly, this study only investigated one commercial golf glove  
10 material. Future studies in this area could investigate the difference between using the leather and  
11 the hybrid gloves. Thirdly, all participants in the present study used an interlock gripping style,  
12 further research should be performed to investigate if different gripping styles have the same  
13 significant effect between wearing a golf glove and not wearing a golf glove when using the Driver.  
14 Finally, testing was limited to an indoor laboratory facility therefore ACD was calculated from the  
15 CHS, BS and launch angle. Further investigation is also required to identify the point between the  
16 Driver and 7-iron where the three performance variables tested are not significantly increased.

17 **Conclusion**

18 To summarise, the results of this study showed a significant increase in CHS, BS and ACD whilst using  
19 a Driver with the glove compared to using a Driver without the glove, however, no significant  
20 differences were evident when using the 7-iron. Muscle activity in the forearm did not change whilst  
21 using the Driver or 7-iron in either of the variables that were tested, therefore, it is unlikely that the  
22 commercial golf glove has any effect on elbow injuries within amateur golfers. The data from this  
23 study suggest that golfers could increase their long game performance by wearing a glove if they  
24 choose to use it whilst using the Driver.

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**Table 1: Mean and SD values for each muscle tested with and without the golf glove, in percentages of MVC**

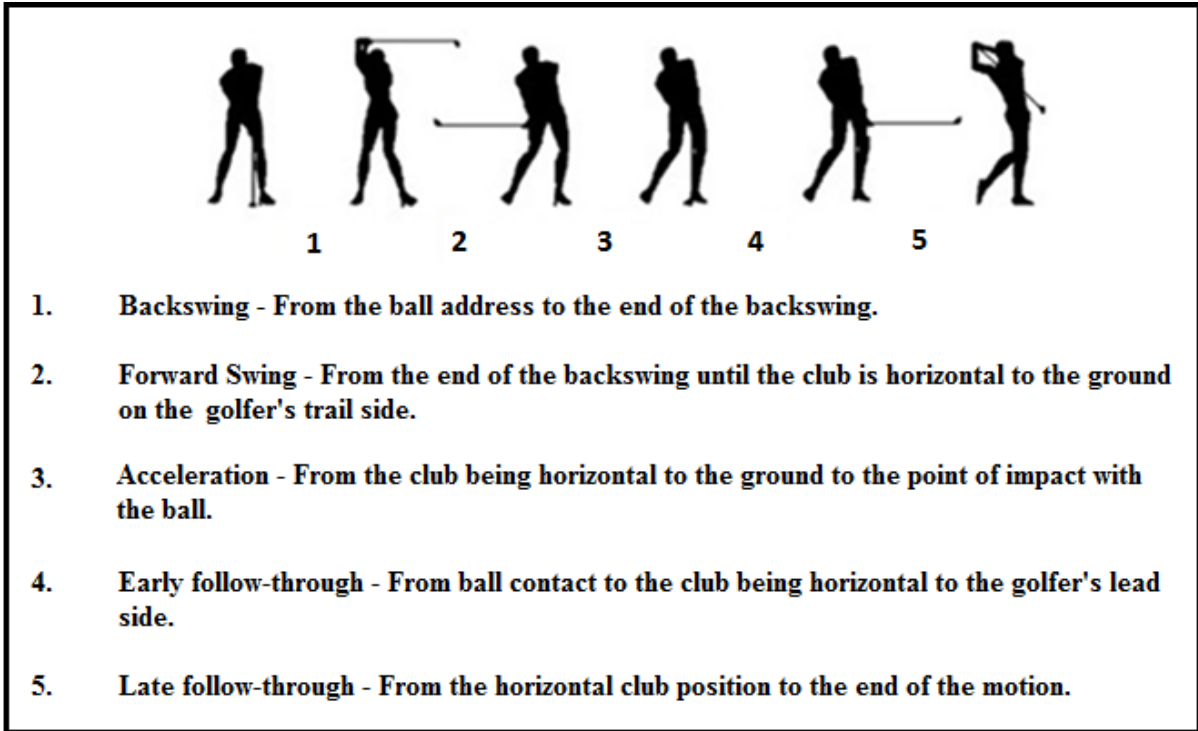
Method	FDS Lead Arm	ECRB Lead Arm	FDS Trail Arm	ECRB Trail Arm	FDS Lead Arm	ECRB Lead Arm	FDS Trail Arm	ECRB Trail Arm
<b>Glove</b>	<b>(Driver G)</b>				<b>(7-iron G)</b>			
Backswing	46.45 ± 18.89	36.78 ± 14.08	24.19 ± 8.20	46.54 ± 17.20	41.77 ± 17.41	35.83 ± 11.76	24.27 ± 7.98	47.83 ± 19.64
Forward swing	63.22 ± 24.80	44.54 ± 20.47	65.27 ± 19.49	59.42 ± 20.73	51.35 ± 19.54	44.79 ± 14.49	68.52 ± 24.46	54.04 ± 19.83
Acceleration	56.76 ± 20.41	69.61 ± 20.15	108.99 ± 30.36	55.35 ± 19.77	55.32 ± 17.42	76.49 ± 21.22	95.92 ± 17.68	55.64 ± 14.16
Early follow-through	46.46 ± 17.32	60.90 ± 23.31	80.06 ± 20.31	53.73 ± 22.68	45.55 ± 15.41	66.86 ± 20.68	67.26 ± 20.74	50.69 ± 18.50
Late follow-through	38.21 ± 17.74	35.40 ± 14.57	44.35 ± 21.35	35.55 ± 14.00	37.71 ± 19.15	32.49 ± 17.02	39.90 ± 17.53	33.08 ± 11.58
<b>No Glove</b>	<b>(Driver NG)</b>				<b>(7-iron NG)</b>			
Backswing	49.37 ± 19.49	37.33 ± 13.67	26.83 ± 9.93	45.13 ± 16.37	42.00 ± 16.67	38.38 ± 14.29	26.01 ± 7.64	48.22 ± 19.32
Forward swing	55.95 ± 20.32	48.49 ± 20.81	67.29 ± 18.08	56.68 ± 17.86	55.09 ± 23.24	46.63 ± 14.78	72.39 ± 20.40	56.24 ± 19.83
Acceleration	62.28 ± 20.25	66.69 ± 27.15	110.24 ± 21.74	62.94 ± 22.48	59.01 ± 19.92	78.62 ± 20.34	94.61 ± 18.80	57.36 ± 20.16
Early follow-through	47.10 ± 16.52	63.90 ± 23.41	85.63 ± 21.60	55.53 ± 21.51	46.84 ± 13.92	68.03 ± 20.68	68.67 ± 17.93	49.54 ± 13.73
Late follow-through	35.69 ± 15.23	35.45 ± 15.72	45.30 ± 23.87	40.46 ± 14.76	39.55 ± 18.60	32.77 ± 17.01	41.46 ± 15.62	34.70 ± 12.14

ECRB - Extensor Carpi Radialis Brevis; FDS - Flexor Digitorum Superficialis

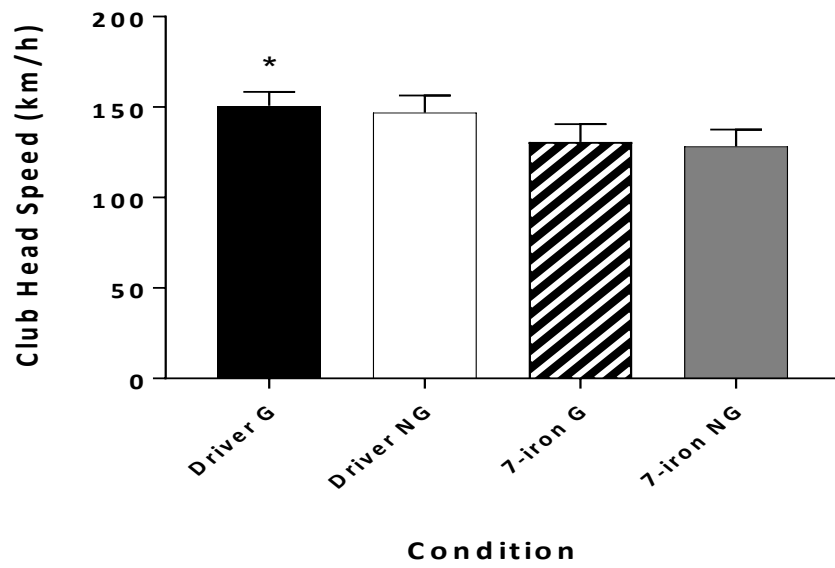
## Tables and Figures



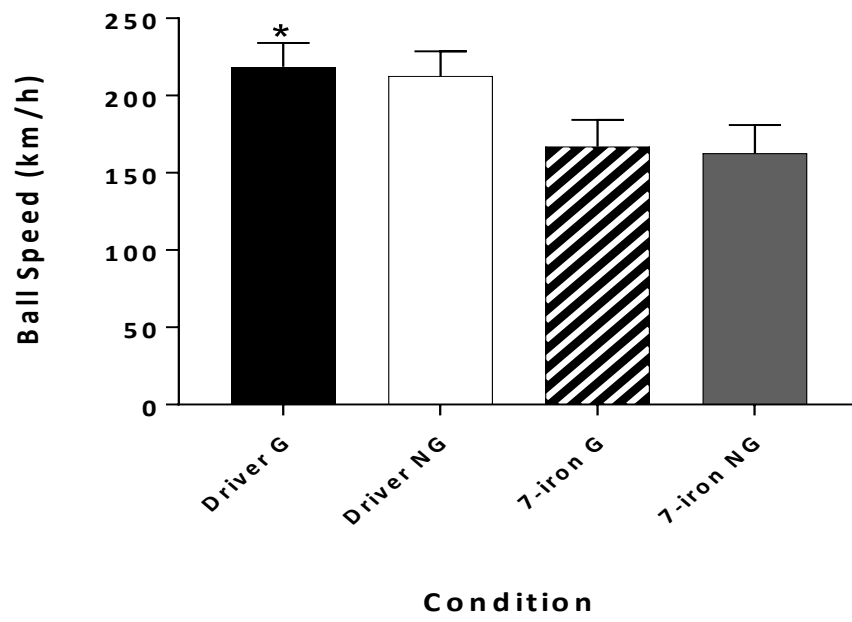
**Figure 1:** Electrodes placed on the FDS and ECRB forearm muscles with transmitters secured to the forearm using Plastic Wrap Cling Film (UK) (Image from Participant 6).



**Figure 2:** Silhouette description of the phases of the golf swing (Farber et al., 2009).



**Figure 3:** Driver G, Driver NG and 7-iron G, 7-iron NG – Club head speed \*Significance between Driver G and Driver NG.



**Figure 4:** Driver G, Driver NG and 7-iron G, 7-iron NG – Ball Speed \*Significance between Driver G and Driver NG.