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Golf Footwear: Effects on Gluteal Muscle Activity & Performance

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- Biomechanics and Physiology

Purpose:

Enhancements in equipment design have become an increasingly important component of sport performance. While golf clubs and balls have seen the most notable developments, golf footwear design warrants equal attention. The effects of shoe sole flexibility on injury and performance has been commonly studied with respect to locomotive activities, however there is a general lack of research regarding footwear in golf. The gluteal muscles are a key muscle group in generating power in the downswing by initiating an optimal kinematic sequence. Gluteal activation and strength are also commonly cited as important factors in injury prevention. Therefore, the purpose of this study was to investigate the effects of shoe sole flexibility on gluteal muscle activity in the golf swing, as well as golfer performance.

Methods:

16 male golfers (age = 30.4 ± 9.2 years old; mass = 85.3 ± 12.9 kg; height = 1.83 ± 0.07 m; handicap = 8.7 ± 9.2) and 10 female golfers (age = 21.4 ± 2.5 years old; mass = 63.0 ± 7.0 kg; height = 1.68 ± 0.05 m; handicap = 3.5 ± 6.9) were tested. All testing was conducted in the Biomechanics Laboratory of the Center for Sport Performance at California State University, Fullerton.

Surface electrodes were applied bilaterally over the gluteus maximus and gluteus medius. Electromyographic (EMG) data was collected using a BTS FREEEMG 1000 (Brooklyn, NY) 8 channel EMG system, sampled at 1000 Hz. Participants performed a maximal countermovement vertical jump, which was used as a dynamic maximal voluntary contraction (MVC) to normalize EMG signals. Participants were fitted with full-body retro-reflective markers. Kinematic data was collected using a 9-camera Qualisys (Gothenburg, Sweden) motion capture system sampled at 240 Hz.

Following a self-selected warm up, participants hit five shots into a golf simulator, in each of three footwear conditions: stiff-soled golf shoes (males: Nike Lunar Control 3; females: Nike F1 Impact), flexible-soled golf shoes (males: Nike TW ’13; females: Nike Free 5.0 TR Fit 4), and barefoot.

Visual3D software (C Motion Inc., Rockville, MD, USA) was used to process all kinematic and EMG data. EMG signals were full-wave rectified and filtered using a Fourth-order, low-pass, double-pass Butterworth filter with a 6 Hz cut-off frequency. A Flight Scope 3D Doppler radar (Stellenbosch, South Africa) was used to collect ball flight variables. All variables were averaged across trials for each participant in each condition.

Males and females were grouped separately due to different footwear models. Repeated measures ANOVAs were used to assess the differences in mean and peak muscle activity, the timing of peak muscle activity, clubhead speed, ball speed, and smash factor, between each of the three footwear conditions within each participant. Additionally, bivariate correlations were performed between all dependent variables.

Results:

There were no significant differences in mean or peak muscle activity during the downswing, nor the timing of peak muscle activity in the downswing, between footwear conditions in either sex. Additionally, there were no significant differences in any ball flight variables between footwear conditions in either sex. There was a moderate negative correlation ($r = -0.395$, $p < 0.05$) between the timing of peak trail gluteus maximus activity in the downswing and clubhead speed.

Despite a lack of statistically significant differences between footwear conditions, participant-specific trends were observed. Approximately half of the participants experienced greater levels of muscle activation and improved performance variables in one footwear condition over the other conditions. Other participants experienced minimal differences or lacked consistent trends between conditions.

Discussion:

This study highlights individual variability in the golf swing. While of a lack of statistically significant differences and consistent trends emerged within the groups, observationally some individuals responded differently to the three footwear conditions (stiff-soled, flexible-soled, and barefoot). In some instances, individual participants exhibited greater overall levels of gluteal activation in one footwear

condition over the others, and typically also produced greater clubhead speeds (up to 4 mph) and carry distances in the corresponding condition. These results would indicate that for some golfers, footwear may affect muscle activity and performance. Further investigation is needed to determine the respective contributions of the magnitude and timing of muscle activation to performance variables and the kinematic sequence.

Practical Application/Clinical Relevance:

This study provides valuable insights into the importance of proper golf shoe fitting. The individual nature of the results indicates that wearing the optimal golf shoe type has the potential to provide considerable performance gains. Golf footwear that promotes greater gluteal muscle activation not only has implications for performance enhancement, but also injury prevention by encouraging use of prime mover muscle groups.

- Please consider for a podium presentation only