Influence of Driver Shaft Stiffness on Female Golfer Thorax and Pelvis Axial Rotation

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Summary

Female golfers tend to exhibit more rotational swing technique than male golfers, suggesting they adopt a different strategy for optimizing golf performance. Yet, how the female golf swing technique and golfer-equipment interaction influence golf performance remains unclear. A cross-sectional experimental study of female golfers swinging four drivers with varying shaft stiffness was conducted to assess both intra- and inter- subject swing technique and how it relates to performance. As anticipated, female golfers achieving similar golf performance metrics (e.g. clubhead speed at impact) utilized individual swing strategies, warranting individualized analyses in response to using different drivers.

Introduction

Assessing biomechanics in golf has been implemented with the aims of reducing injury risk and improving swing technique and golf performance. Clubhead speed at impact is commonly reported in biomechanics research as it is measurable and impacts resulting ball launch characteristics. Greater thorax axial rotation and separation between the thorax and pelvis (i.e X-factor) have been associated with greater clubhead speed in male golfers [1]. As female golfers are highly reliant on individual swing technique and exhibit great central segment rotation than males [2], the relationships to increase clubhead speed identified in male research may not be relevant to female golfers. While previous research has focused on group comparisons to male golfers, less attention has been given to intra-individual swing techniques and effects on golf performance. To date, female golf biomechanics research has not assessed the interaction between female golfers and different club properties. Therefore, the aim of this study was to investigate the thorax and pelvis axial rotation and golf performance changes when using their own driver and drivers with varying shaft stiffness.

Methods

Upon receiving informed consent and ethical approval, six female golfers (22.3 ± 3.4 years old; 7.9 ± 5.0 handicap) completed biomechanics testing in an indoor lab with their own driver and three test drivers. The test drivers were matched by driver head, swing weight, but varied by shaft stiffness (Driver A (Stiff Flex), B (Regular Flex), and C (Soft-Regular Flex)). Golfers were blinded to club conditions. Golfers completed two swings with their own driver, then five swings with a test club, followed by two more swings with their own driver. This process was repeated until 10 balls were hit with each of the test drivers [3].

Sixty-three retroreflective markers were attached to the golfer to collect full-body kinematics. Sixteen motion capture cameras (800 Hz), two high speed cameras (160 Hz), and two force plates (1600 Hz) were used to collect kinematic and kinetic data. Golf performance data was collected using the Trackman Launch Monitor System (TrackMan A/S, Vedbæk, Denmark). Pearson's correlation coefficients were calculated to determine relationships between clubhead speed at impact and biomechanical variables at the top of the backswing.

Results and Discussion

The average clubhead speed was 86.6 ± 4.9 mph. Pearson correlation coefficient revealed moderate negative relationships between clubhead speed and thorax axial rotation (r = -0.69), X-factor (r = -0.69), and pelvis axial rotation (r = -0.57) at top of backswing. It is unsurprising that greater X-factor and central segment rotation corresponded with greater clubhead speed [2]. However, when looking at two golfers with similar clubhead speeds (S1, 90.5 mph; S2, 90.9 mph), it is apparent that different thorax axial rotation was used to achieve similar golf performance outcomes (Figure 1). There were noticeable differences in axial rotation between their own driver and test drivers.

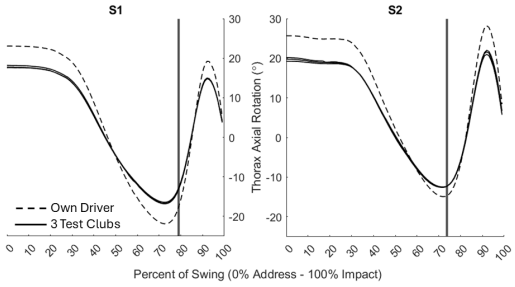

Figure 1: Thorax axial rotation throughout the golf swing for two representative golfers. Clubs are indicated by line style. Top of backswing is indicated by the vertical line.

Conclusions

Though measurable performance outcomes may be similar, female golfers utilize their own swing strategy to achieve this outcome. Differences observed between the golfer's own driver and the test clubs may be a result of personal equipment vastly differing from test clubs. Ongoing research aims to further explore how female golfers respond to drivers with varying shaft stiffness and how these differences impact golf performance at both individual and group levels.

Acknowledgments

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References

[1] Joyce, C et al. (2013). *Sports Biomech.*, **12**: 108-120.
[2] Brown SJ. et al. (2011) *J. Sports Sci.*, **29**: 1483-1491.
[3] Worobets J. et al. (2012). *Sports Biomech.*, **11**: 239-24