CHANGES IN TECHNIQUE WHEN PLAYING GOLF FROM UPHILL AND DOWNHILL LIES

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Introduction

Most biomechanics research in golf has been carried out on flat artificial surfaces. A slope of 2.25° has been shown to be enough for golfers to alter their setup (Linde, 2005), which has been found to be 50% of all tee-to-green shots (Peters, Smith and Lauder, 2015). Coaching literature (Leadbetter, 1993) and a review of online coaching videos (Nolan, Blenkinsop and Hiley, 2022) show that the advice, specifically when playing from uphill/downhill shots, is to position the ball forwards/backwards in the stance, which may cause the clubface angle at contact to be more closed/open. Golfers are also advised to orientate their spine perpendicular to the slope they are on. The current study aimed to quantify differences between uphill, downhill, and flat shots and compare this to current coaching advice. It was hypothesized that alterations in the golfers' spine angle and ball position at address would occur, with changes to the clubface direction at impact.

Methods

Right-handed mid-handicap (10-15) and low-handicap (<5) golfers were recruited. Analysis of four golfers was completed in this ongoing study, with two from each handicap group (mid 1 & 2; age 29 & 60, height 1.85 & 1.9 m, mass 85 & 95 kg and handicap 10.6 & 11.9; low 1 & 2; age 21 & 18, height 1.83 & 1.75 m, mass 73 & 82 kg and handicap +1.9 & 4.1). Eight randomly ordered shots were played on the flat and each slope at 5°, produced by a Stewart platform. Golfers were instructed to hit a full shot that would finish on the aiming line, applying their usual adjustments. Club and body kinematic data were collected with 61 retro-reflective markers using 3D motion capture (Vicon), labelled, and exported to MATLAB for further analysis. To adjust for changes in aim direction, ball position was calculated by projecting the ball marker perpendicularly onto a line between the two heel markers and given as a percentage of that distance (0% = left heel 100% = right). Three markers on the clubface were used to determine its angle relative to the target line at contact, where contact was set as the time where the plane of the clubface reached the radius of the ball. Spine angle (left/right lean) was determined using the C7 and T10 markers in relation to the global coordinate system. An average of the 8 shots per condition was calculated for each variable.

Results and Discussion

All golfers moved the ball position backwards on downhill shots by an average of 5%. However, the mid-handicap golfers also moved the ball backwards during the uphill trials by 4%, contrary to coaching advice. One low-handicapper (low 1) moved the ball noticeably forwards on the uphill (35%), and backwards on the downhill (47%) compared to the flat shots (43%), perhaps suggesting that a strategy had been developed for these shots. On average, the spine angle of the golfers followed the coaching advice, with a slight lean to the right on uphill slopes (5.2°) and relative lean to the left on downhill slopes (1.5°) compared to the flat (4.2°). However, these angle changes are less than the angle of the slope (5°), so the advice to orientate the spine perpendicular to the slope was not followed. The average clubface angles on the flat ranged between 3.2° closed to 4.8° open. There was no noticeable pattern for three of the golfers, however one low-handicapper (low 1) impacted the ball with a more closed face (3.5°) and a relatively more open face (1.5°) compared to the flat (3.2°). This was the same golfer with the noticeable ball position movements which may explain the change in clubface angle at impact. The results indicate that there may be strategies used by golfers to set up differently to uphill/downhill slopes. These adjustments may lead to changes in impact characteristics that would affect the subsequent ball flight, however more research is needed to verify these links.

Significance

This work provides new information in a significant part of the game where little research has been carried out. The results suggest that some golfers may have strategies in their setup to cope with uphill/downhill slopes, flowing coaching advice, whereas others seem to make no adjustments, thus highlighting the need for individual and group analysis in future. Research can now assess how the adjustments can change the outcome of the shot, which can lead to evidence based coaching strategies.

Acknowledgments

The authors would like to thank all golfers who took part in the research.

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