THE EFFECT OF SHOE TYPE ON A GOLFER'S STABILITY

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INTRODUCTION

The role of the shoe in the golf swing should be to provide a solid base of support for the application of forces and comfort and relief from strain to the musculoskeletal system (Williams and Cavanagh, 1983). Because the actions at the feet are critical to the golfer's performance, a shoe that is effective in providing necessary stability is required. Without the necessary stability, changes in the kinetics and kinematics of the swing may occur and thus lead to inaccurate shot results. Therefore, the purpose of this study was to compare the ground reaction force and in-shoe pressure patterns between different shoes during the golf swing.

METHODS

To study the role of stability of the golf shoe, twelve right-handed male golfers with a mean age of 30.3 years (± 9.7) were utilized. All subjects were experienced golfers with self-reported handicaps of 12 or less.

In-shoe pressure measurements, using a Tekscan in-shoe pressure measurement system, were recorded in each shoe simultaneously at 100 Hz. The in-shoe pressure system was used to determine the center of pressure (COP) of the foot inside the shoe. The dependent in-shoe measures consisted of the mediolateral (ML)and antero-posterior (AP) excursions of this center of pressure. Ground reaction forces for each foot were collected for the same trials using two separate A.M.T.I. force platform systems sampling at 319 Hz. The force platforms had a carpet covering that aided in maintaining the stability of the golfer during the swing. Each time a golfer performed a trial, the position of his shoe was recorded. The shoe-ground COP was then determined and the excursions in the ML and AP direction were determined. Identification of address and contact involved the use of a pressure sensor beneath the ball and the hitting surface. A light was iluminated while the golfer was in the address position (AD) as well as at contact (CON). This circuit was also interfaced to a microcomputer via an analog to digital converter so that the end of AD and CON could be identified in the ground reaction force data. These positions were verified and maximum backswing (MB) was identified using a NAC high speed video camera operating at 200 Hz. The positions were identified using retroreflective markers placed on the hands (in the middle of the third metacarpal) and on the club head and shaft.

Shoe characteristics were measured using an Exeter Research (Exeter Research, Inc. Exeter, NH) flexion and torsion tester. The stiffness (Nm/degree) of each shoe for the flexion test was measured at the ball of the feet, while the torsion tester measured the stiffness when twisting the shoe. During each testing session, five trials in each of the five shoes were collected for each subject.

The shoes in this study consisted of prototype and in-production golf shoes and in-production athletic shoes. The shoe types were: 1) a no-heel traditional golf shoe (NHTG), a traditional golf shoe (TGS), an athletic golf shoe (AG), a running shoe

(RS), and a cross training shoe (CT). Both the NHTG and TGS shoes had traditional spike arrangements.

Each golfer performed five trials (i.e. swings) in each shoe. They were asked to hit golf balls into an indoor driving net using a five iron golf club. The result of the shot was determined by the investigator and also by self report of the golfer.

The data were statistically analyzed using a one-way repeated measures ANOVA with post-hoc tests when appropriate. The level of significance was set a priori at 0.05.

RESULTS

The results of the flexion and torsion tests are presented in Figures 1 and 2. In the flexion test, significantly higher ($p<0.05$) stiffness values were observed in each of the traditional golf shoes. The athletic golf shoe was significantly less than the other four shoes. The torsion test results were similar to the flexion test results. Both traditional golf shoes were significantly more stiff ($p<0.05$) than the other shoes. The athletic golf shoe was not the most easily torqued shoe.

Analysis of the actions recorded during the swing focused on changes in the movement of the COP at the ground-shoe and shoe-foot interfaces. Comparison of the movement of the COP from end of address to contact was used to indicate the relative stability of each shoe. The occurrence of the maximum deviation of the COP in the antero-posterior and mediolateral direction relative to AD and CON was assessed both in-shoe and at the ground-shoe interface. The AP movement of the right and left foot for each shoe is presented in Figures 3 and 4 respectively. Figure 3 demonstrates a significant difference between the NHGS and the two non-golf shoes (RS and CT) at the right foot. The in-shoe center of pressure was the smallest in the golf shoes. In-shoe movement of the center of pressure observed in the RS shoe was significantly larger than the AG shoe, and approaching significance between the running and traditional style golf shoes (NHTG and TGS). The COP movement of the left foot (Figure 4) was similar to that observed in the right foot. The COP movement of the RS and CT were larger than the movement observed the golf shoes. Mediolateral movement of the COP demonstrated no significant differences between shoes (Figures 5 and 6).

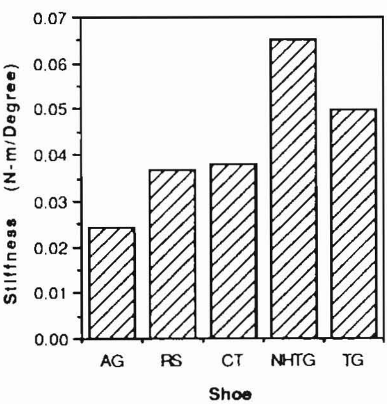

Figure 1. Flexion test results.

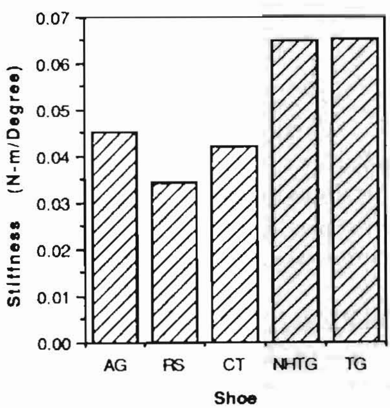

Figure 2. Torsion test results.

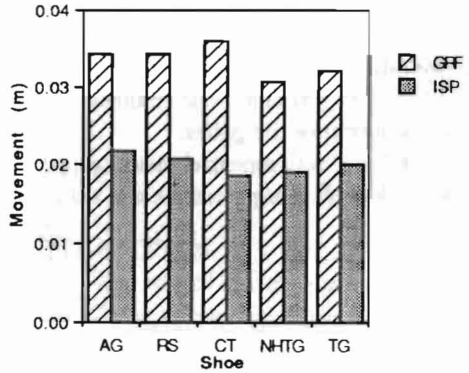

Figure 3. AP COP movement of right foot from address to contact.

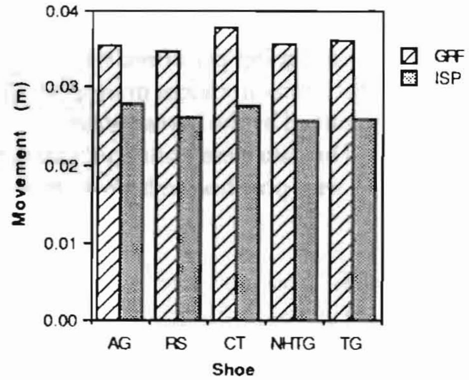

Figure 4. AP COP movement of left foot from address to contact.

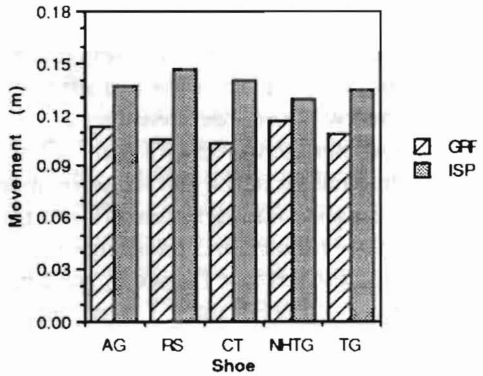

Figure 5. ML COP movement of right foot from address to contact.

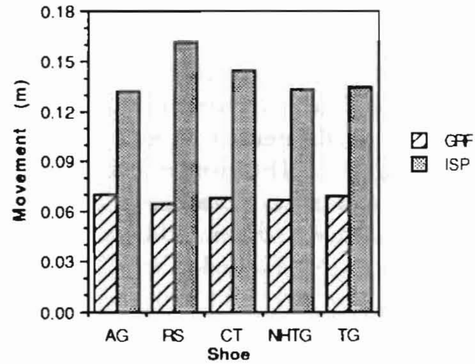

Figure 6. ML COP movement of left foot from address to contact.

DISCUSSION

The differences observed due to changes in shoe type were in the AP direction. Those shoes with the smallest torsion stiffness values demonstrated the most movement of the antero-posterior COP when measured at the foot-shoe interface. Stability during the swing is affected more in the antero-posterior direction than in the medio-lateral direction when shoe type is manipulated.

REFERENCES

Williams, K.R. and P.R. Cavanagh. (1983). The mechanics of foot action during the golf swing and implications for shoe design. Med Sci Sports Exer 15(3):247-255.