

# EFFECT OF GOLF SWING STYLES ON RESULTANT JOINT MOMENTS OF LOW BODY JOINTS AND L4/L5

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## INTRODUCTION

Recently, technical differences between one-plane and two-plane swing style are the most popular issues in golf swing coaching.

The one plane golf swing introduced by Jim Hardy [2] explains, the arms will be on the same plane as the shoulders at the top of the swing, whereas in a two plane swing the arms and shoulders are said to be on different planes, thus, creating two distinct movement patterns from the top of the swing through impact and follow through. However, there have been no investigations about the effect of two golf swing styles on the resultant joint moments of ankle, knee, hip, and L4/L5 which may imply golf injuries.

This study is to investigate the effect of two golf swing styles based on RMS deviation of the club head trajectory from swing plane (single-plane and multiple-plane swing styles) on the resultant joint moments in multiple lower body joints and L4/L5.

## METHODS

In the previous study [3], RMS deviation of the club head trajectory from the swing plane was proved as an effective method to evaluate the swing plane. Therefore, RMS deviation of the club head trajectory from the swing plane was used to verify the group difference. There was significant difference in RMS deviation between two groups (single-plane group:  $3.5 \pm 1.1$  mm; multiple-plane group:  $8.8 \pm 1.6$  mm,  $p < .01$ ).

Six right-handed professional golfers (Handicap 1 or lower) participated in the study: 3 subjects for single-plane group (height:  $180.3 \pm 6.4$  cm; mass:  $84.5 \pm 16.0$ ; age:  $29 \pm 8.5$  years) and 3 subjects for multiple-plane group (height:  $180.7 \pm 3.2$  cm; mass:  $81.8 \pm 9.0$ ; age:  $37.3 \pm 16.1$  years).

From attached reflective markers, nineteen markers (Left ASIS, Mid-PSIS, Left lateral thigh, left lateral epicondyle, left medial epicondyle, Left lateral shank, Left lateral malleolus, Left medial malleolus, Left heel, Left toe, Right ASIS, Right lateral thigh, Right lateral epicondyle, Right medial epicondyle, Right lateral shank, Right lateral malleolus, Right medial malleolus, Right heel, Right toe) were used in the analysis process as shown in the Figure 1.

All subjects completed 3 trials of driver shots and the best one trial was analyzed. The resultant joint moments of left ankle, left knee, left hip and L4/L5 were computed by inverse dynamics. Resultant joint moments in multiple lower body joints and L4/L5 were assessed in a phase; from the address at ball to vertical club shaft position after impact. Modified Lariviere et al (1998)'s model was used for calculation of resultant joint moment of L4/L5 spine.

Eight digital cameras were used in 60 Hz each trial. AMTI OR6-5 force plate was used to collect force and moment data sampled at 100 Hz. Paired t-test was used to find if there was significant difference between two groups with SPSS v15.

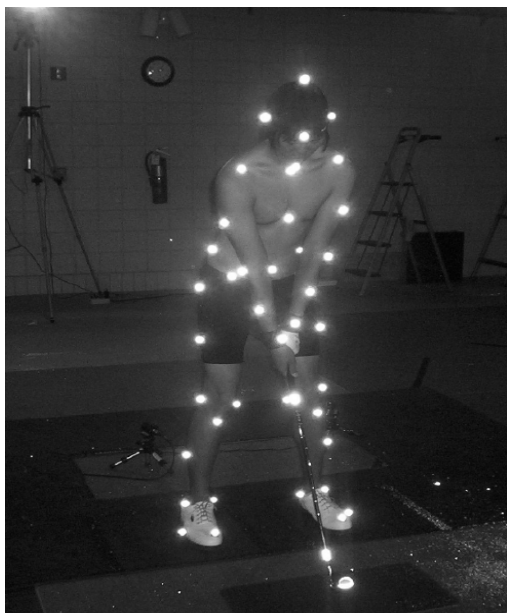


Figure 1: Marker positions

L4/L5, whereas multiple-plane group used much greater joint moment in left ankle. This may suggest that single-plane group is at much high risk of L4/L5 injury, whereas multiple-plane group is at much high risk of left ankle injury during golf swing of driver.

## REFERENCES

1. Lariviere, C. and D. Gagnon. Comparison between two dynamic methods to estimate triaxial net reaction moments at the L5/S1 joint during lifting. *Clinical Biomechanics*. 13:36-47, 1998.
2. Hardy, J., & Andrisani, J. (2004). *The plane truth for golfers*. New York: McGraw-Hill.

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## RESULTS AND DISCUSSION

The resultant joint moments of low body joints and L4/L5 for the each group are presented in Table1.

Two golf swing styles have different mechanisms.

Single-plane group used much greater joint moment in

Table1. Peak resultant joint moment normalized by body weight (N·m / N)

	Left ankle	Left knee	Left hip	L4/L5
<b>Single-Plane Group(n=3)</b>	0.0753±0.016	0.249±0.061	0.631±0.113	1.359±0.109
<b>Multi-Plane Group (n=3)</b>	0.177±0.075*	0.359±0.167	0.635±0.165	0.999±0.062*

\* Significantly different from matching joint (p < .05)