

## TRUNK MOTION DURING THE GOLF SWING OF ELITE GOLFERS

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**INTRODUCTION:** The key requirement of a successful golf swing is an accurate impact. The body and arm motions during the backward and forward swings must be executed in such a way that an accurate impact is secured. Novice golfers experience difficulties in coordinating the arm and body motions due to the complexity of the mobility system formed by the trunk and arms. Differentiation of the abnormal swings causing inaccurate impact from normal swings through in-depth trunk motion analysis is thus of importance. The purpose of this study was to provide a biomechanical profile of the normal golf swing in terms of trunk motion ranges and patterns with the aim of establishing baseline data for comparative studies.

**METHODS:** Five healthy male, right-handed, collegiate golfers (age =  $23.5 \pm 1.5$  yrs, height =  $174.6 \pm 5.6$  cm, mass =  $75.4 \pm 8.6$  kg, and handicap =  $3.4 \pm 0.6$ ) with no history of low-back pain participated in this study. A seven iron was used in the swing trials while subjects were wearing their own golf shoes. Eight reflective markers (1 cm in diameter) were placed over the C7, T12, posterior and anterior superior iliac spines, and the lateral portion of the acromion process of the scapula. Trunk motions were captured with six 60-Hz synchronized CCD cameras. A 500-Hz high-speed video camera (FOR.A, Japan) was also used to observe ball impact. Standard 3-dimensional motion analysis was performed and the relative orientations of the trunk to the pelvis were quantified.

**RESULTS AND DISCUSSION:** At address, the trunk showed a left-axially rotated (-ve), right-laterally bent (-ve), and flexed (+ve) position followed by the right-axially rotated (+ve), right-laterally bent, and flexed position at the end of back swing (Table 1). The trunk was right-rotated ( $19.4 \pm 9.7^\circ$ ), left-flexed ( $37.8 \pm 5.2^\circ$ ) at impact with the flexion/ extension returned close to the address position. Trunk rotation ranges were  $71^\circ$  and  $40^\circ$  for the right and left axial rotations, respectively with the backswing showing a larger rotation. The trunk reached neutral bending position ( $0^\circ$ ) at the end of the backswing while showing right-bent position at both the address and impact position.

**Table 1 Trunk Angle (TA) and Peak Trunk Angle (PTA) during Golf Swing with 7-Iron (Mean  $\pm$  SD) (unit:  $^\circ$ ).**

	Address			Back swing top			Impact			End of swing		
	AR	LB	FE	AR	LB	FE	AR	LB	FE	AR	LB	FE
TA	-10.9 (5.7)	-10.3 (6.3)	17.8 (11)	58.7 (4.0)	-1.1 (5.2)	7.5 (12)	19.4 (9.7)	-37.8 (5.2)	16.6 (3.4)	-51.1 (9.7)	-24.6 (5.1)	-20.1 (14.3)
PTA					0 (7.5)		60.7 (4.0)		22.4 (9.2)		-40.7 (3.4)	

\* Abbreviations:AR-axial rotation (+: right), LB-lateral bending (+: left), and FE-flexion/extension(+:flexion)

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