

Lumbopelvic Kinematic Characteristics of Golfers With Limited Hip Rotation

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Background: While the biomechanical characteristics of the golf swing are well established, the lumbopelvic kinematic characteristics of professional golfers with limited hip internal rotation warrant further investigation.

Purpose: The specific aim was to ascertain mechanical differences in lumbopelvic-hip movement of asymptomatic professional golfers with and without limited hip internal rotation during the golf swing.

Study Design: Controlled laboratory study.

Methods: Thirty professional male golfers (aged 25-35 years and 0 handicap matched) were classified into either the limited hip internal motion (LHIM) group (range of motion $<20^\circ$) or the normal hip internal motion (NHIM) group (range of motion $\geq 30^\circ$). All participants underwent clinical tests (muscle strength, muscle length, and range of motion) and a biomechanical assessment using 8 infrared optic cameras in a motion analysis system. Independent *t* tests were performed to determine potential mean differences in muscle strength, length, and range of motion and lumbopelvic kinematics at $P < .05$.

Results: Kinematic analysis revealed that the LHIM group showed significantly greater lumbar flexion ($P < .001$), right and left axial rotation ($P < .025$), and right-side lateral bending ($P = .003$) than the NHIM group. A greater pelvic posterior tilt was observed in the LHIM group when compared with the NHIM group ($P = .021$). Clinical tests showed reduced internal rotator muscle strength and shorter muscle length in the iliopsoas ($P = .017$) and hamstring ($P < .001$) among those in the LHIM group when compared with the NHIM group.

Clinical Relevance: The study data suggest that constraints to hip joint internal rotation, along with muscle strength imbalances between the agonist and antagonist muscles and muscle tightness, are associated with substantially greater lumbopelvic movement during the golf swing.

Keywords: golf; limited hip rotation; lumbopelvic kinematics; muscle imbalance

Limited hip joint mobility is an important biomechanical marker of low back pain (LBP) in golfers.^{24,36,54} Globally, LBP is a common occurrence in approximately 55 million golfers.^{12,25} Empirical evidence suggests that the biomechanics of LBP is characterized by limited hip joint mobility^{4,6,17,24,32,47,54} and associated imbalance in muscle strength and length.^{2,17,32,38-40,42,49} When compared with golfers without LBP, those with a history of LBP exhibit limited hip joint mobility during hip internal rotation of

the lead side (eg, left hip for a right-handed golfer) and lumbar extension.⁵⁴ In fact, recent clinical evidence showed that improved internal rotation mobility along with lumbar stabilization exercises helped achieve pain-free golf swings and performance.^{23,45} Biomechanically, limited hip joint mobility may interfere with the efficient transmission of kinetic energy from the lower extremities to the lumbopelvic kinetic chain, thereby causing excessive compensatory lumbar rotational stress during the golf swing.^{17,54} An understanding of the biomechanical relationship between angular displacements of the hip joint and peak rotational angles in the lumbar spine may thus render important clues for the biomechanics of golfers with LBP.

Muscle imbalances in strength and length are recognized as important causes of limited hip joint mobility and associated movement impairment.^{7,15,49,54} The term "muscle balance" was first coined by Janda^{20,21} and describes a relative equality in muscle strength between the agonist (eg, internal hip rotators) and antagonist (eg, external hip rotators) muscles.⁴³ Decreased iliopsoas and hamstring muscle length or flexibility has also been shown to contribute to limited hip joint mobility and lumbopelvic

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