

ORIGINAL ARTICLE

Effects of the Abdominal Drawing-In Maneuver on Muscle Activity, Pelvic Motions, and Knee Flexion During Active Prone Knee Flexion in Patients With Lumbar Extension Rotation Syndrome

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ABSTRACT. Park K-N, Cynn H-S, Kwon O-Y, Lee W-H, Ha S-M, Kim S-J, Weon J-H. Effects of the abdominal drawing-in maneuver on muscle activity, pelvic motions, and knee flexion during active prone knee flexion in patients with lumbar extension rotation syndrome. *Arch Phys Med Rehabil* 2011;xx:xxx.

Objective: To investigate the effects of performing an abdominal drawing-in maneuver (ADIM) during active prone knee flexion on the hamstrings and erector spinae muscle activity, the amounts of pelvic motion and knee flexion, and onset of pelvic movements.

Design: Comparative, repeated-measures study.

Setting: University research laboratory.

Participants: Men patients (N=18) with lumbar extension rotation syndrome.

Intervention: Subjects performed prone knee flexion in 2 conditions.

Main Outcome Measures: To measure muscle activity, surface electromyogram (EMG) of both erector spinae and the medial and lateral hamstrings was performed. Kinematic data on the pelvic motion and knee flexion were measured using a 3-dimensional motion analysis system. Repeated 1-way analysis of variance was used for the statistical analysis.

Results: Significantly decreased electromyographic activity in the right and left erector spinae and significantly increased electromyographic activity in the medial and lateral hamstrings activity were shown during prone knee flexion in ADIM condition using the pressure biofeedback unit. In addition, the amounts of anterior pelvic tilt, pelvic rotation, knee flexion, and perceived pain decreased significantly during prone knee flexion in the ADIM condition compared with the same maneuver in the non-ADIM condition. The onset of anterior pelvic tilt and pelvic rotation occurred significantly earlier in the non-ADIM condition, compared with the ADIM condition.

Conclusions: ADIM effectively increased activation of knee flexors, decreased activation of back extensors, and reduced the

pelvic motions and low back pain during prone knee flexion in patients with lumbar extension rotation syndrome.

Key Words: Knee; Low back pain; Rehabilitation.

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PPRONE KNEE FLEXION is often used to measure the length of the rectus femoris muscle, to strengthen the hamstrings, and to test for upper lumbar radiculopathy.¹⁻³ In addition, active prone knee flexion is performed to classify movement impairment of the painful lumbar spine, because active movement of the limb may influence the symptoms.³⁻⁶ While performing active knee flexion in the prone position, excessive lumbopelvic motion can occur.⁴ Scholtes et al⁷ reported that there was excessive lumbopelvic rotation at a smaller knee flexion angle in patients with low back pain (LBP) during knee flexion in the prone position compared with subjects without LBP.

Previous research states that people with LBP report aggravated LBP with prone knee flexion and therefore advocated modification that involved manual and voluntary abdominal control during prone knee flexion.⁴⁻⁹ Other researchers revealed that when the painful movement pattern was modified, such as by limiting lumbopelvic rotation, symptoms in people with LBP were reduced or eliminated.¹⁰⁻¹³ One method to facilitate improved abdominal control is the abdominal drawing-in maneuver (ADIM) using a pressure biofeedback unit during lower-limb movements. Lumbar stabilization using a pressure biofeedback unit has been studied during hip extension in the prone position and hip abduction while lying on the side; these researches showed that excessive pelvic motions were prevented with significantly increased agonist activation in healthy subjects.^{14,15}

Sahrmann⁴ and Harris-Hayes et al⁵ stated that patients with lumbar extension rotation syndrome showed pelvic rotation and anterior tilt during active knee flexion in the prone position. Sahrmann⁴ and Van Dillen et al⁸ classified LBP into 5 subgroups: lumbar flexion syndrome, lumbar extension syndrome, lumbar rotation syndrome, lumbar flexion rotation syndrome, and lumbar extension rotation syndrome. Lumbar ex-

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List of Abbreviations

ADIM	abdominal drawing-in maneuver
CI	confidence interval
EMG	electromyogram
LBP	low back pain
RMS	root mean square
VAS	visual analog scale