

# Effects of Lumbopelvic Neutralization on the Electromyographic Activity, Lumbopelvic and Knee Motion during Seated Knee Extension in Subjects with Hamstring Shortness

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**Abstract.** [Purpose] The purpose of this study was to examine the effects of lumbopelvic neutralization on the angle of knee extension, lumbopelvic motion, and the electromyographic (EMG) activities of the quadriceps, hamstrings, and rectus abdominis muscles of subjects with hamstring shortness during seated knee extension.

[Subjects] Twenty young subjects (14 men, 6 women) with hamstring shortness were recruited for this study.

[Methods] A pressure biofeedback unit was used to monitor the lumbopelvic neutralization during seated knee extension with lumbopelvic neutralization. The EMG activity and kinematic data were measured during seated knee extension with and without lumbopelvic neutralization. Surface EMG was used for measuring the muscle activities of the quadriceps, hamstrings, and rectus abdominis muscles. The angles of knee extension, lumbar flexion, lumbar rotation, and posterior pelvic tilt were measured using a 3-dimensional motion analysis system. [Results] The angles of the lumbar flexion, lumbar rotation, posterior pelvic tilt, and knee extension decreased significantly when performing seated knee extension with lumbopelvic neutralization compared to performing the same maneuver without lumbopelvic neutralization. The EMG activities of the medial and lateral hamstrings, quadriceps, and rectus abdominis decreased significantly during seated knee extension with lumbopelvic neutralization using a pressure biofeedback unit. [Conclusion] Seated knee extension exercise with lumbopelvic neutralization may be useful for minimizing compensatory lumbopelvic motion and preventing compensatory hamstrings and rectus abdominis muscle activities of subjects with hamstring shortness during seated knee extension.

**Key words:** Hamstring shortness, Knee extension, Lumbopelvic neutralization

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## INTRODUCTION

Knee extension exercises in the sitting position are commonly prescribed to strengthen the quadriceps, stretch shortened hamstrings, and train the control of compensatory lumbar flexion-rotation in patients with back and knee pain<sup>1-5)</sup>. Additionally, knee extension in the sitting position is often used to classify low back pain in the movement control test<sup>6,7)</sup>. Patients with hamstring shortness can exhibit compensatory lumbopelvic motions when performing knee extension exercises due to their shortened or stiff hamstrings, and this can be prevented if the exercise is performed correctly<sup>2,8)</sup>.

Studies have emphasized the use of lumbar stabilization with an abdominal drawing-in maneuver using a pressure biofeedback unit to maintain lumbopelvic stability during hip abduction and extension performed by healthy subjects

in the side-lying and prone positions<sup>9,10)</sup>. Keeping the lumbopelvic region in the neutral zone when performing lower extremity strengthening or stretching exercises and the activities of daily living has been reported to reduce the risks of cumulative tissue stress in the lumbar region, ligament injury, and posterior disc herniation<sup>7,11-13)</sup>. Keeping the neutral zone of lumbopelvic motion means that low back lordosis is similar to that of upright standing without any motions of lumbar vertebrae such as flexion, extension, rotation, or side bending<sup>13,14)</sup>.

If an individual has a lumbopelvic joint that is relatively more flexible than the hip joint, he or she will not be able to maintain the neutral zone of lumbopelvic region and lumbopelvic compensatory motion, such as lumbar flexion and/or posterior pelvic tilt, will occur during seated knee extension<sup>2)</sup>. Currently, verbal instruction and tactile sensation using the hands are commonly used to monitor