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Comparison of Lumbar Stability During Postures and Motions of Low Back Pain Patients and Controls

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Background and aims
Lumbar stability is one of the crucial mechanical factors of low back pain (LBP). Previous researches have shown that different types of motor patterns were observed during a wall-plank-and-roll test between healthy individuals and LBP patients. Our aim of this study was to compare lumbar stability during 10 static postures and 8 dynamic motions between LBP patients and healthy control groups. To compare the stability of the lumbar spine among the postures/motions.

Methods
30 patients with LBP and 30 healthy individuals aged 22 to 67 years were included. The subjects performed 10 static motions (4 sitting postures, 3 desk jobs and manipulating a smartphone at the face/chest/knee-level) and 8 dynamic motions (chair stand, bend over to pick up, squat down to pick up, walk, walk up and downstairs, squat, wall-plank-and-roll, tripod stability) with three inertial sensors attached on the thoracic spine and sacrum. Relative angles between the sensors were calculated to analyze the lumbar lordosis angle. With average KL angle, delta KL angle, lordosis robustness index (LoRI) indicators compared to the patients and the control groups in static postures. And in dynamic motions, the average KL angle, RMS of angular velocity, and lordosis robustness index (LoRI) index were compared between the two groups. A comparison was also made between postures and motions.

Results
Delta KL angles of LBP patients were significantly higher than healthy subjects when performing keyboard tasks with a standard computer monitor and manipulating a mobile phone at the chest-level ($p < 0.05$). LoRI was the highest when sitting with a backrest including lumbar roll, and the lowest when sitting hunched both in LBP and healthy subjects. The average KL angle was the highest when sitting with a backrest including lumbar roll, and the lowest when performing writing tasks on the desk. The RMS of angular velocity was significantly higher in the LBP group than healthy subjects when performing tripod stability ($p < 0.05$). And significantly lower ROM during walking was observed in the LBP group compared with the controls ($p < 0.05$).

Conclusions

The conclusion of this study, which quantified lumbar lordotic curvature and stability. Sitting with backrest is the most secure posture on the lumbar spine. Nevertheless, the most unstable posture is sitting hunched. And, Patients with low back pain have a poor ability to maintain lumbar lordotic curvature in keyboard tasks and using smartphones at chest levels. Patients with low back pain are more unstable when performing tripod stability motion than normal controls. From this point of view, TS motion may be used to quantify and monitor the lumbar stability of patients with back pain. This kinematic biomarker can be used to compare the adequacy of various postures and to provide guidance for the rehabilitation of Low Back Pain patients.