Utility of portable inertial measurment unit (IMU) sensor system for spinal movement assessment in people with and without low back pain.

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Introduction: Physical examintion of spinal movement behaviour is a routine part of clinical assessment of LBP. Typically this involves an observation of the patients' posture and movement behaviour and a visual estimate of range of motion and its quality. Portable sensor technologies offer an exciting alternative with growing evidence of its use to evalaute spinal/pelvic movement behaviour in people with LBP[1]. Limited evidence exist as to whether sensors can used to obtain clinically useful evaluation of spinal movement behaviour to guide exercise management for LBP.

Purpose: Demostrate the application of portable intertial measurement unit (IMU) sensor system for spinal and pelvic regional movement analysis in people with and without LBP.

Method: Observational cross-sectional study investigated spinal and pelvic kinematics of 58 participants with LBP and 12 matched pain-free controls. Four portable IMU sensors (Xsens technologies B.V., Netherlands) were affixed to the skin with double sticky tape over the participants' 1st thoracic spinous process to obtain trunk kinematics (T), 2nd and 4th lumbar spinous process for upper (ULx) and lower lumbar spine (LLx) kinematics and the sacrum for the pelvic kinematics[2]. Participants were asked to perfom 10 repetitions of forward bend with no instructions provided. Minimum, maximum and mean range of motion (ROM) and respective coefficient of variation (CV) for each variable was calculated and compared between groups using independent t-test.

Results: Compared to pain-free controls, people with LBP demonstrated significantly lower mean and maximum ROM in the trunk, ULx and LLx regions ($p<0.05$). There was no between group difference in the minimum spine ROM nor in any of the measured variables in the pelvis. No significant difference was detected in the movement variability with mean CV ranging between 2.9 and 4% in both groups.

Conclusion: This is a first to date study utilising multiple IMU sensors to evaluate spinal-pelvic kinematics during forward bend task in people with and without LBP. This study clearly demonstrates that people with and without LBP consistently adopt different movement strategies when performing typically perceived pain provoking forward bend task.

Relevance: The results demonstrate potential clinical utility of IMU sensors to evalaute spinal kinematics in LBP population. All 3 spine sensors detected difference in mean and maximum ROM thus a single IMU sensor may be sufficient, further enhancing the clinical usefulness. Further analysis are currently conducted to explore the utility of IMU sensor system for spinal assessment within subsets of LBP and as a form of movement feedback during exercise.

References:

[1]Papi et al (2018) JBiomech 64,186-197.

[2]Hemming et al (2018) ESJ 27(1),163-170.