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A new electronic spinal mobility Index for axial spondyloarthritis using inertial measurement unit sensors

Philip Gardiner^{A1}, Dawn Small^{A2}, Pedro Machado^B, [Karla Muñoz Esquivel](mailto:karla.munoz-esquivel@ulster.ac.uk)^{C1}, Joan Condell^{C2}, Juan Luis Garrido-Castro^D

^{A1,2} WHSCT, Altnagelvin Area Hospital, Glenshane Road, Derry/Londonderry, BT47 6SB, Northern Ireland, UK

^B University College Hospital and National Hospital for Neurology & Neurosurgery, Queen Square London, WC1N 3BG, UK

^{C1,2} Ulster University, Magee campus, Intelligent Systems Research Centre, Northland road, Derry/Londonderry, BT487JL, Northern Ireland, UK, kc.munoz-esquivel@ulster.ac.uk, +447948172610

^D University of Cordoba, Department of Computer Sciences and Numerical Analysis, Albert Einstein building, Rabanales Campus, C.P 14071, Córdoba. Spain.

Background/Introduction:

A key measure for axSpA is spinal mobility, but this is highly variable and subjective when assessed using conventional tools (Mancini and Horak, 2010). Cervical rotation is the only movement test measured in degrees in the BASMI. Inertial Measurement Unit (IMU) sensors can attain accurate measures of body motion. Hence, we evaluated the reliability of IMU attained measurements - from movement tests performed by axSpA participants - against measurements attained from conventional BASMI - the 'Truth' dimension of the OMERACT filter (Wells, Beaton, Tugwell, *et al.*, 2014).

Material & Methods:

Spinal movements were tracked using ViMove IMU sensors from 40 axSpA participants with a wide range of disease severity (mean duration of 13 years). Sensors were set: (1) at the lumbar level (over T12 and S1) and (2) at the cervical level (over occiput and T3) for monitoring back and neck movements respectively. Patient-reported outcomes and conventional metrology were also collected. Intra-rater, inter-rater and test-retest reliability were performed. Lumbar and cervical angles of maximum Range Of Movement (ROM) were attained and analysed using Intraclass Correlation Coefficients. Six values - anterior flexion/extension, lateral flexion and rotation for the lumbar and cervical regions - were employed to calculate a composite score (IMU-ASMI). Pearson correlation coefficients with BASFI were calculated for each component as well as the overall score.

Results:

IMU measures showed reliable equivalence with the comparable BASMI measurements, correlating closely: Cervical rotation, side flexion, lumbar flexion and cervical flexion with values of r equals to 0.85, 0.84, 0.62 and 0.65 respectively. The correlation between BASMI (mean 4.8, range from 1.2 to 8.4) and IMU-ASMI (mean 4.0, range from 0.1 to 9.3) scores was 0.88. The correlations between "BASFI and BASMI" and "BASFI and IMU-ASMI" were 0.68 and 0.71 respectively. Unforeseen lumbo-pelvic restriction patterns were observed in 15 out of 40 participants. The clinical relevance of IMU sensors tests is giving a detailed overview of movement limitations in degrees by region and movement type.

Conclusion:

IMU measures showed reliable equivalence with the comparable BASMI measurements. Unforeseen lumbo-pelvic restriction patterns were found. Vi Move IMU sensors were highly reliable in measuring spinal movements.

References:

Mancini, M. and Horak, F. B. (2010) 'The relevance of clinical balance assessment tools to differentiate balance deficits', *European journal of physical and rehabilitation medicine*, 46(2), pp. 239–248. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/20485226>.

Wells, G., Beaton, D. E., Tugwell, P. *et al.* (2014) 'Updating the OMERACT filter: discrimination and feasibility', *The Journal of rheumatology*. 2014/04/01, 41(5), pp. 1005–1010. doi: 10.3899/jrheum.131311.