A Move Toward Precision: Innovations in Measuring Spinal Mobility in Axial Spondyloarthritis

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The efficacy of therapeutic interventions in axial spondyloarthritis (axSpA), including its more severe subset of ankylosing spondylitis (AS), is measured primarily using variables that reflect inflammatory activity. Most clinical trials have relied on the Assessment of Spondyloarthritis international Society 20 (ASAS20) or ASAS40 response as primary endpoints, whereas the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), and particularly the Ankylosing Spondylitis Disease Activity Score, have proven useful for monitoring disease activity longitudinally.1,2 Another important consideration in axSpA is spinal mobility. Reduced spinal mobility is included in the modified New York (mNY) criteria for AS.3 Both inflammation and structural damage compromise mobility in the spine in axSpA.4 A number of tests are available to measure various aspects of spinal mobility, including the well-known Schober test for lumbar flexion.5 The Bath Ankylosing Spondylitis Metrology Index (BASMI) is a validated composite score that includes 5 measurements: cervical rotation, tragus-to-wall distance, lumbar flexion, lumbar lateral flexion, and intermalleolar distance, the latter being a measurement of hip joint integrity.6 However, limited precision and sensitivity to detect change represent challenges for using the BASMI or individual tests of spinal mobility in research.7 No instruments that measure spinal mobility are included in the updated ASAS core outcome set.8

In 2 recent studies, Kiefer et al leveraged an electronic tool, the Epionics SPINE device (ES), for more accurate spinal mobility measurements.9,10 The ES comprises 2 strips of motion sensors linked to a computer. The sensor strips are attached to the back of the proband, parallel to the spine, 5 cm left and right of the midline, reaching from the level of the C7 spinous process to the posterior superior iliac spine. The subject is then asked to perform a series of movements (lumbar flexion and extension, lateral bending, and spinal rotation) as fully and as quickly as possible. The exercise is performed 3 times and the ES records both the degree (range of motion [ROM]) and the speed (range of kinematics [ROK]) of the movements, with lower scores representing worse performance.11

An earlier study by the same researchers had demonstrated that patients with axSpA underperformed when compared to healthy controls using the ES and that patients with radiographic axSpA had worse spinal mobility than patients with nonradiographic axSpA.9 In this issue of The Journal of Rheumatology, the effect of syndesmophytes on spinal mobility was assessed using the ES.10 The study involved 103 patients with axSpA, 72 with radiographic and 31 with nonradiographic disease; 43 patients had evidence for syndesmophytes on spinal radiographs. The patients with axSpA who had syndesmophytes were older than those without syndesmophytes, with a nonsignificant trend for longer disease duration. Both groups had comparable BASDAI values. The study confirmed a negative correlation between ES measurements and the BASMI. Importantly, the presence and number of syndesmophytes showed a negative correlation with ES measurements and there appeared to be a correlation between the presence of syndesmophytes and reduced mobility in the affected spinal segments.

Limitations of the study, acknowledged by the authors, include the small sample size and incomplete structural assessment of the spine. Radiographic damage in the spine is commonly measured using the modified Stoke Ankylosing Spondylitis Spinal Score (mSASSS) score, which relies on lateral radiographs of the cervical and lumbar spine.12 However, complete mSASSS data were available for only 55 of 103 subjects. The mSASSS itself has well-known limitations. Only the anterior corners of vertebral bodies in the cervical and lumbar spine are assessed, leaving out the posterior and lateral edges of the vertebral bodies, facet joints, spinous processes, as well as the entire thoracic spine.13

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Another limitation of the study is the simple cross-sectional design precluding a comparison of longitudinal measurements of ES values, BASMI, and BASMI components. The ES used in the study also has the limitation that the functionally very important movements in the cervical spine cannot be assessed. Tape measures, goniometers, and plain film radiography hail from centuries past. The studies by Kiefer et al introduce modern technology into axSpA metrology. The ES measurements have construct validity and promise to be more reliable than conventional spinal mobility measurements. Moreover, the inclusion of kinetic measurements may provide insight into determinants of spinal mobility beyond structural damage to the bony spine. For instance, abnormalities of the paraspinal muscles in axial SpA have been described but mechanisms are poorly understood.14 We still lack an understanding of morning stiffness. Is morning stiffness a subjective phenomenon or associated with measurable changes of spinal mobility? Although Kiefer et al did not report the time of day when measurements were performed, this might be a question that can be addressed with a precise measurement tool. Applying the sensor strips to the back of the proband and performing the measurements analyzed by Kiefer et al takes about 15 minutes.11 Combined with the hardware cost of the device, this makes it unlikely that the ES will be used to monitor patients with axSpA in clinical practice. However, further technical refinement may reduce the amount of time needed to attach the sensors to the proband. Several recent studies have used inertial motion units, similar to the sensors in the ES, to measure spinal mobility in axSpA.15–18 One should expect that this competition will lead to design optimization. In the future, it might also be possible to quantify spinal mobility using cell phone apps that take advantage of methods developed for augmented reality applications in and outside of medicine. The ES reported by Kiefer et al and similar motion sensing devices are a first step in a new direction by introducing precision into measuring spinal mobility.

REFERENCES