Introduction: The goal of most motion preserving technologies is to maintain the normal center of rotation (COR). However, measurement of the COR is imprecise in the spine. Panjabi (1979) showed that for motions of less than 5°, there is an error of greater than 10mm in the location of the COR. Clinical studies (Anand, 2010) reported a median flexion/extension range of motion (ROM) of 3.5°. Another quality indicator, Interpedicular Travel (IPT) has the difficulty that IPT is associated with ROM; the greater ROM, the greater IPT. As an alternative, we propose evaluating the ratio of IPT/ROM (the Kinematic Indicator), as a way of describing motion quality. The purpose of this study is to assess the Kinematic Indicator's ability to describe a set of clinical motion data from patients undergoing surgical treatment for lumbar spinal stenosis.

Methods: Maximum voluntary flexion-extension radiographs were obtained preoperatively from 70 single level patients as part of an IDE study of a pedicle screw based dynamic stabilization device. The radiographs included a calibration marker. The radiographs were independently assessed using validated, computer assisted methods accurate to better than 1° and 1mm. Interpedicular distance was measured between the mid-pedicular axes of adjacent vertebrae using points slightly posterior to the superior articular process of each vertebra. IPT was calculated as the difference in interpedicular distance in flexion minus that in extension. ROM was measured using end plate markers. Rotation and IPT were measured at the index level. Data for each patient was plotted on a graph of IPT vs. ROM and a best fit line created through the data. The $R^2$ value for the line fit was evaluated to determine the effectiveness of the approach.

Results: The average age of the patients was 58 years of age (range: 35-82). The L4-L5 level represented 78% of the index levels, with remainder at L5-S1, L3-L4 and L2-L3. The median rotation at the index level was 3.5° (range 13.1°). The median IPT at the index level was 2.3mm (range 10.5mm). The graph of IPT vs. ROM is shown in Figure 1, including the best fit line. The best fit line had a slope of 0.71, passed through the origin and $R^2$ equaled 97%.

Discussion: The best fit line described 97% of the variation in the data, showing that Kinematic Indicator performs well in describing the kinematics of the population. The slope of the line was 0.71, which we define as the Kinematic Indicator. The value is similar to that derived from Wharton (2009), of 0.68 (9.2mm of IPT and 13.6°ROM) examining asymptomatic individuals. In conclusion, the Kinematic Indicator appears to provide a good representation of motion quality and may be useful in evaluating in vivo kinematics for different motion preserving technologies.