The altered kinematics resulting from posterior dynamic stabilization in the lumbar spine has implications as to the longevity of implants, directly through screw loosening and breakage, and indirectly through altered biomechanics associated with stress shielding. It has been postulated that semi-rigid or dynamic fixation provides a more favorable motion distribution, a potentially advantageous benefit for both fusion and maintenance of physiologically safe adjacent level stresses. In this study, the authors evaluated the kinematics of a novel posterior dynamic stabilization (PDS) system, TRANSITION®, when used adjacent to rigid fixation in a calf model.

Three intact calf spines (T12-L5) were tested by applying a pure moment of ±10 Nm. The displacement control protocol for testing adjacent level effects was applied, as described by Panjabi. Initially, the total T12-L5 range of motion (ROM) was determined in an individual intact specimen. In all subsequent tests for the respective specimen, the displacement of the spine was set as the intact total ROM values in flexion-extension. A series of two load/unload cycles were performed for each motion with data analysis based on the final cycle. All three specimens were tested in the following sequence:

1. Intact;
2. Bilateral rigid fixation at L3-L4 [anterior integrated spacer and plate, INDEPENDENCE®, with posterior pedicle screws and titanium rod, REVERE® Stabilization System, Globus Medical];
3. Bilateral transitional fixation with a semi-rigid L2-L3 and rigid L3-L4 fixation [anterior integrated spacer and plate, INDEPENDENCE®, and TRANSITION® at L2-L4]; and
4. Bilateral rigid fixation at L2-L4 [anterior INDEPENDENCE® at L3-L4 with posterior pedicle screws and titanium rod at L2-L4, REVERE® Stabilization System, Globus Medical].

Unless otherwise stated, when percentage change is discussed, the percentages are calculated through differences in normalized ROM of surgical groups when normalized to the intact spine motion (100%). Test results showed that single-level rigid fixation led to hypermobility at the super-adjacent level of 117% (Figure 1). Subsequently there was a sharp change in between fixated and non-fixated segmental ROM from 15% (rigid, L3-L4) to 117% (uninstrumented, L2-L3). Incorporation of a flexible TRANSITION® element between rigid and uninstrumented levels created a ROM profile which varied from 20% (rigid, L3-L4), to 47% (flexible, L2-L3) to 102% (uninstrumented, L1-L2), following a trend of “doubling” motion of each sequential segment. Therefore, the TRANSITION® device provides a less abrupt change in stabilization from rigidly fixated to completely uninstrumented. One limitation of this study is the lack of correlation between biomechanics and in vivo behavior following incorporation of the graft material into a fusion. In this respect, the present biomechanical model represents the stress situation immediately post-operatively or following posterolateral fusion.