INTRODUCTION
Some clinicians use mechanically based manual interventions in attempt to reduce low back pain under the assumption that altering motions, postures and loads can reduce pain [1]. However, the mechanism of pain alteration remains unknown. The purpose of this study was to investigate the contributions of a number of biomechanical factors associated with pain alteration. It was hypothesized that 1) coaching and cueing specific movement patterns would alter instantaneous pain in low back pain patients, and 2) if hypothesis 1 was true, these changes in pain would be reflected in changes in quantitative stability, joint load and posture (referred to as the “criterion variables”).

METHODS
A convenience sample was formed with four low back pain patients seeking consults for pain relief at a back pain clinic. All could produce “catches” of pain with movement. Manual interventions involving coached changes in motion patterns, muscle activation patterns and posture were used in an attempt to reduce pain. EMG and kinematic data were collected prior to and post intervention using a Vicon motion tracking system (MX20 cameras, Vicon Motion Systems). These data were input to an anatomically detailed spine model that calculated muscle force, joint compression and shear, and eigenvalues associated with the potential energy based approach for assessing spine stability. All of these variables, together with lumbar spine position (criterion variables) were assessed to obtain insight as to the mechanism of pain alteration.

RESULTS
Each subject exhibited different pain provocation activities and sensitivities together with different responses to the suggested interventions, therefore each subject was treated as a case study. Using a clinically significant criterion of pain reduction greater than or equal to 2, 3 of the 4 subjects reduced pain immediately upon the intervention. Using a change of 10% as a criterion for biological significance for the criterion variables, it was clear that the mechanism was different in each individual. For example, subject 1, in a heel drop test, reduced the provoked pain score from 1 to 0 with a muscle bracing pattern that focused on latissimus dorsi, which increased stability at the L4 lumbar level. Subject 2, in performing several tasks, obtained substantial pain reductions with different bracing/stiffening strategies (e.g. from pain 5 to 3), resulting in increased ML shear. Subject 3 eliminated pain (pain from 5, 6 or 7 to 0) with shifting movement from the spine to the hips and stiffening the torso, but in this situation, stability at the L4 and L5 level was increased.

DISCUSSION & CONCLUSIONS
In three of the four subjects, there was a clinically significant reduction in pain, providing support to the first hypothesis that altering movement and muscle activation patterns can change instantaneous pain. Further, these changes in pain were typically reflected in the criterion variables, supporting the second hypothesis. Based on the four case studies presented here, altering motions, postures and loads (i.e. biomechanical variables) altered pain intensity, but there does not appear to be one common biomechanical “critical” variable was effective for all.

In summary, immediate pain reduction can be achieved by altering muscle activation and movement patterns. However, the combination for optimal success appears to be different for every individual. Thus clinical treatments/interventions must be “tuned” for each individual and this requires trial and error. This suggests that patient classification schemes may need more refinement to address this heterogeneity.

REFERENCES