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Research Paper Review

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Can Altering Motions, Postures, and Loads Provide Immediate Low Back Pain Relief?
A Study of 4 Cases Investigating Spine Load, Posture, and Stability

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ABSTRACT

Study Design: *A quantitative biomechanical analysis of mechanism of pain alteration in 4 cases of low back pain.*

Objective: *To investigate the contributions of a number of biomechanical factors associated with pain alteration.*

Summary Of Background Data: *Some clinicians use mechanically based manual interventions in attempt to reduce low back pain. However, the mechanism of pain alteration remains unknown.*

Methods: *A sample was formed with 4 patients with low back pain seeking consults for pain relief. All could produce "catches" of pain with movement. Manual interventions involving coached changes in motion and muscle activation attempted to reduce pain. Electromyographic and kinematic data were collected before and after intervention. These data were input to an anatomically detailed spine model that calculated muscle force, joint compression and shear, and spine stability.*

Results: *Using a clinically significant criterion of pain reduction of 2 or more, 3 of 4 subjects reduced pain immediately upon the intervention. Using a change of 10% as a criterion for biological significance for kinematic and kinetic variables, each subject demonstrated a different reaction. For example, subject 1 demonstrated increased stability, subject 2 increased mediolateral shear, subject 3 increased mediolateral shear and decreased spine flexion, and subject 4 increased stability. The pain-reducing interventions required to obtain these results were also different for each individual.*

***Conclusion**: Immediate pain reduction can be achieved by altering muscle-activation and movement patterns. However, the combination for optimal success seems to be different for every individual. Pain provocation tests help to "tune" the intervention. This also suggests that patient-classification schemes may need more refinement to address this heterogeneity.*

ANALYSIS

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Background Information
While assessing and managing patients with low back pain (LBP), many manual medicine providers successfully utilize mechanically-based manual interventions, including movement and spinal loading alteration strategies.

In theory, most LBP patients report movements or activities that aggravate (and arguably, may have originally initiated) their LBP. These can include specific motions, postures, or external loads that can result in tissue irritation and pain. Some patients also exhibit patterns suggestive of 'instability', characterized by painful 'instability catches' during movement (from flexion to neutral standing, for example). It is thought that this type of symptom is a manifestation of poor motor control – suboptimal muscle activation patterns in and around the lumbar spine during movement. Such changes, based on the current state of the literature, could be both causes and consequences of LBP.

The flip side of this theory is that as clinicians, we may be able to identify exacerbating positions and tasks via provocative testing, tailoring treatment and rehabilitation interventions accordingly with a goal or reducing pain and further tissue insult. Corrective exercises are commonly used in such cases, often immediately reducing or eliminating pain in these patients.

Despite the widespread use of this approach, the mechanism behind how such interventions relieve pain is still largely unknown. Therefore, the aim of this four patient case series was to examine whether changes in movement and muscle-activation patterns could alter spine stability and stiffness, joint loading, posture and movement. The authors proposed 2 hypotheses:

1. Coaching/cueing specific movement patterns would immediately alter reported pain in LBP; and (if hypothesis #1 is true)
2. These changes would quantitatively change stability, joint loading, and posture.

PERTINENT RESULTS

This is the first time a case series has been reviewed on Research Review Service. I believe there is value in all types of research, and in this particular study the value is not in the details/data of the individual cases, but rather the concepts and take-home messages.

3 of 4 subjects reduced pain immediately with the individually prescribed intervention. Using a change of 10% as a criterion for biological significance for kinematic and kinetic variables, each subject demonstrated a different reaction, resulting in different prescribed strategies to reduce pain. I know I said the details were not paramount here, but to illustrate: subject 1 demonstrated increased stability, subject 2 increased mediolateral shear, subject 3 increased mediolateral shear and decreased spine flexion, and subject 4 increased stability. As you can see, these pain-reducing interventions were different for each individual.

Having said that, the most important overall results from this case series are:

- No two subjects experienced pain relief with the same combination of coaching cues and movements.
- By investigating pain-provoking postures and movements, clinicians can effectively cue and prescribe pain-relieving motions for individual patients.

CLINICAL APPLICATION & CONCLUSIONS

This was a very interesting study that provided insight into the relationship between instantaneous pain and alterations in various biomechanical variables created with coaching and cueing of movement and muscle activity.

In 3 of the 4 subjects studied, there was a clinically significant reduction in pain, supporting the authors' first hypothesis that altering movement and muscle-activation patterns can have an immediate impact on pain levels. Altering motions, postures, and loads can modulate pain intensity. But (this is the important part), there does not seem to be 1 common "critical" biomechanical variable that was dominant in producing the effect. This finding has 2 important implications:

1. Patients are individuals – meaning what works for one person may not work for another. Customizing the movements and cues provided will help your patients obtain optimal pain relief.
2. The biomechanical variables chosen here are sensitive to pain modulation, but they differ on the - basis of the mechanism of pain. For example, increased muscle activation can stiffen the spine, but this stiffness comes with higher compressive loads – something a clinician must bear in mind based on the patient's history and assessment results.

Overall, the interplay between spinal stiffness/stability and the forces related to pain elimination seems to be patient-specific. This is a crucial take-away from this case series, and implies that although provocative testing helps to identify possible interventions, the intervention needs to be specific to the individual patient to be most effective.

STUDY METHODS

This was a quantitative biomechanical case series involving 4 patients with low back pain, who were selected for movement causing 'catches' of pain during daily activity. Each subject was assessed utilizing provocative testing to identify motions, postures and loads that exacerbated their pain – these tests have been described in detail in Dr. McGill's textbook (1).

Instrumentation:
Full-body kinematics were recorded using 14 body markers, placed bilaterally on: medial and lateral malleoli and femoral condyles, greater trochanter, iliac crest, and acromion. Force plates measured external forces and EMG recordings were taken from 12 bilateral muscle locations: rectus abdominis, internal oblique, external oblique, latissimus dorsi (LD), upper erector spinae, and lower erector spinae.

Procedure:
Each subject performed a variety of pain provocation tests to identify their individual exacerbating activities (see below). Subjects performed these tasks while EMG, kinetic, and kinematic data were simultaneously collected. During these tasks, they also reported pain levels on a Numeric Pain Rating Scale (from 0-10, a change of > 2 was considered clinically significant). Then, a clinical kinesiologist utilized verbal and manual cues to alter motion and muscle-activation patterns, aiming to immediately reduce or remove the patient's pain. These techniques included bracing the abdominal wall and/or latissimus dorsi muscle, and using a hip hinge movement technique (see below).

The pain provoking/relieving tasks included (with corresponding positive subjects):

1. Heel drop test 1 (Subjects 1, 2 and 3)
2. Lifting a 45-lb bar from a 45-cm height (Subject 2)
3. Unloaded squat (Subjects 2, 3 and 4)
4. Sit-to-stand (Subject 4)
5. Stand-to-sit (Subject 4)
6. Jump off a 45-cm stool (Subject 3)

Cues

Abdominal brace: subjects were asked to stiffen their abdomen by "hardening" their abdominal wall musculature with manual cues. The level of activation was "tuned" to find optimal pain reduction.

Latissimus Dorsi (LD): subjects were instructed to depress the shoulders while stiffening the pectoralis and LD muscles in a co-contracted state.

Hip hinge: involved flexing about the hips rather than flexing or moving the spine when bending over.

Once the subject understood and executed the new technique, the particular task was repeated, recollecting EMG, kinetic, and kinematic data.

STUDY STRENGTHS / WEAKNESSES

Strengths

- Unique approach to the case study/series design
- Results support the notion that patients are unique, and that sub-grouping of LBP patients should be a critical goal in LBP research and clinical care
- Integration of anatomical, biomechanical and clinical research into patient assessment and treatment

Weaknesses

- The decision to use 10% as a cut-off for 'biological significance' is arbitrary for kinematic and kinetic variables, but the authors discussed this appropriately, stating that muscle activity changes in patients are often imprecise, and that changes < 10% are likely imperceptible to a patient.

Additional References

1. McGill SM. Low Back Disorders: Evidence-Based Prevention and Rehabilitation. Champaign, IL: Human Kinetics; 2007.