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New Perspective: Outcome Measurement Indices for Yoga Therapy

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Low back pain (LBP) is among the most common musculoskeletal symptoms [1]. The reported lifetime prevalence of pain and associated disability ranges from 54% to more than 80%, and the point prevalence rate is around 20% in the general population [2]. Although the burden of LBP is not clearly reported, more effective interventions including yoga therapy could potentially lead to cost savings.

Yoga therapy has been shown as an effective intervention for treating chronic or recurrent LBP [3-5]. Yoga practice may increase muscle strength, endurance, proprioception, and balance while emphasizing movement through a full range of motion (ROM) to increase flexibility and mobility [6]. For example, the rhythmic intervals of breath retention during yoga therapy could help rhythmic intervals of lumbar stability. The kinetics causing intra-abdominal pressure gradients may proceed independent of conscious, neuromuscular control [7]. However, previous studies on yoga therapy mostly utilized pain/disability questionnaires or quality of life tools to compare the limited effectiveness following the intervention [3-6].

An exercise program intended to be a regime of treatment for LBP is usually designed to improve function at the impairment level, such as pain and limited ROM, by improving muscular strength, muscular endurance, trunk flexibility, and/or cardiovascular endurance [8]. Therefore, postural control in subjects with chronic LBP might require objective measurements on complex processes involving integrated motor function for impaired balance performance [9,10].

It has been reported that subjects with LBP demonstrate aberrant motion during dynamic movements [11-14]. The co-ordination of trunk mobility during functional movements depends on flexibility and stability with optimal spinal ROM. More importantly, core muscle strengthening for spinal stability would be critical through yoga therapy. In addition, the functional approaches to treatment may provide a practical approach to the LBP problem [4,15,16].

Although wide ranges of exercise intervention have been developed and many are currently in use [3,16,17], there is conflicting evidence concerning the effectiveness of specific exercises for specific conditions. None of the available exercise interventions has emerged as the most commonly accepted treatment approach of choice for LBP. This problem may not be entirely the result of ambiguity of the effectiveness of the methods, but could be at least partially due to a lack of an outcome measure that serves as a meaningful, commonly accepted gold standard by which to compare the effectiveness of the various methods.

A recent study indicated that yoga intervention decreases functional disability, pain intensity, and depression at the 6-month follow-up in subjects with LBP [4]. Another study indicated that yoga yields an incremental cost-effectiveness intervention for treating subjects with chronic and recurrent LBP [3]. However, there is a lack of evidence regarding the effect of kinematic changes in trunk stability and/or flexibility following yoga intervention.

In this regard, our motion analysis lab developed an objective tool to evaluate comprehensive postural sway during the one-leg standing test [18-21]. The measurements of relative holding time (RHT) and relative standstill time (RST) during one-leg standing might be good postural measurement tools for yoga therapy intervention. These measurements were able to determine balance performance since subjects stand on one leg with the contra lateral hip flexed 90 degrees to maintain body stability [18,20,21].

The RHT was defined as the ratio between the successful holding time and the requested holding time. The subjects were instructed to stand on one leg for 25 seconds (requested holding time); if they stood for 25 seconds (successful holding time), then the ratio was calculated as 1. Therefore, the successful holding time was indicated as the total holding time until the subject failed to maintain stability during the holding test protocol.

The RST was defined as the ratio between the sum of standstill time and successful holding time. The standstill time was measured within the threshold from the postural fluctuation on the force plate. This standstill time was the summation of the tested axis on the force plate that goes below threshold (5 degrees). Therefore, the RST represents the duration when the foot was in a static position on the force plate [18,20,21]. In this way, a comprehensive evaluation of postural balance could be compared based on normalized kinetic indices during one leg standing following the yoga therapy.

Furthermore, it is also evident that the kinematic changes for the stability of the lumbar spine relative to the core spine could be affected in subjects with LBP who exhibit proprioceptive deficits [22,23]. In our previous studies, the core spine was the direct upward perpendicular line from the pelvic plane of the second sacrum level [18,20,21]. The pelvic plane included both sides of the anterior superior iliac spine and the second sacrum level. Therefore, the lumbar spine motion, which was affected by the pelvis and thorax, may be evaluated more accurately by three-dimensional relative motion from the core spine. Both holding time and kinematic changes from the core spine measurement would be a comprehensive objective tool since postural evaluation requires a process involving integrated motor function for impaired balance performance in subjects with LBP [18-21].

A trunk muscle imbalance may also contribute to unbalanced postural activity, which could prompt a decreased, uncoordinated bracing effect in subjects with LBP. As a result, possible kinematic rehabilitation training such as yoga intervention could be used in the prevention of falls in such subjects. Yoga is important to enhance both biomechanical and neuromuscular differences in subjects with LBP. Further investigation is required to evaluate stability and functional mobility of the spine following the intervention.

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Yoga intervention has been regarded as safe with no adverse events as well as clinically significant improvements in functional disability and present pain intensity in LBP subjects compared to control subjects [4]. Therefore, the increased muscle strength, proprioception, and balance following the intervention could be objectively measured by the single leg standing test for kinetic as well as kinematic changes. It was expected that some variability exists; however, the kinematic changes suggest coordination of postural adjustability, which is the composite output of proprioceptive feedback. As a result, proprioceptive feedback training might be beneficial since postural sway has been associated with low back symptoms [24].

The LBP attributed to spinal disorders directly affects postural stability and balance deficits for detecting impairment [18]. Therefore, specific and customized exercise programs, such as yoga therapy are required for subjects with LBP for balance performance. In order to maintain postural stability components within a certain ROM during single leg standing, the body requires not only reliable sensory feedback or muscle activation from all involved joints, but also the sensitive response of proprioceptive receptors to environmental changes.

Yoga exercise intervention and outcome assessment should be integrated into functional tasks for pain reduction and flexibility in subjects with LBP. In this regard, clinicians should consider outcome measurements with single leg standing tests for postural sway which help prevent further injury by limiting an individual's response rate to external perturbations. This objective outcome measurement could be beneficial to quantify objective progress from yoga therapy for subjects with LBP.

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