Short-term response of hip mobilizations and exercise in individuals with chronic low back pain: a case series

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Study design: A case series of consecutive patients with chronic low back pain.
Background and purpose: In patients with chronic low back pain (CLBP), the importance of impairments at the hip joints is unclear. However, it has been postulated that impairments at the hip joints may contribute to CLBP. The purpose of this case series was to investigate the short-term outcomes in patients with CLBP managed with impairment-based manual therapy and exercise directed at the hip joints.
Methods: Eight consecutive patients (mean age: 43.9 years) with a primary report of CLBP (>6 months) without radiculopathy were treated with a standardized approach of manual physical therapy and exercise directed at bilateral hip impairments for a total of three sessions over approximately 1 week. At initial examination, all patients completed a numeric rating pain scale (NPRS), Oswestry disability index (ODI), fear-avoidance beliefs questionnaire (FABQ), and patient-specific functional scale (PSFS). At the second and third treatment sessions, each patient completed all outcome measures as well as the Global Rating of Change (GROC).
Results: Five of the eight (62.5%) patients reported 'moderately better' or higher (>+4) on the GROC at the third session, indicating a moderate improvement in self-reported symptoms. These five individuals also experienced a 24.4% reduction in ODI scores.
Discussion: This case series suggests that an impairment-based approach directed at the hip joints may lead to improvements in pain, function, and disability in patients with CLBP. A neurophysiologic mechanism may be a plausible explanation regarding the clinical outcomes of this study. A larger, well-controlled trial is needed to determine the potential effectiveness of this approach with patients with CLBP.

Keywords: Chronic low back pain, Hip, Impairment, Lumbar, Manipulation, Manual therapy

Background

From 1992 to 2006, it is estimated that the prevalence of chronic low back pain (CLBP) increased 6.3% and, subsequently, more people with CLBP are seeking treatment.[1] Low back pain (LBP) is the most common reason for lost work days,[2,3] second most common reason for an individual to see a primary care physician,[4] and the third most common reason for hospital admission.[5] Approximately one in four individuals have experienced a significant episode of LBP, which prompted them to seek medical attention within the previous 3 months,[6] whereas 80% of individuals will experience an episode of LBP during their lifetime.[7] The rate of recurrence of LBP is high[8,9] and many seek alternative treatment options such as acupuncture.[10,11] While 89% of patients with a new episode of LBP have persistent pain and disability at 3 months,[10] 75–78% of patients continue to have persistent pain and disability at 12 months.[10] Additionally, utilization of healthcare resources has increased, with several studies showing significantly increased rates of spinal injections,[12–14] surgery,[6,15,16] and use of opioid medications.[17,18] Individuals with CLBP are more likely to seek care for their symptoms[19–21] and utilize more health care resources compared to patients with acute LBP.[22–24]

Individuals with CLBP are commonly treated by physical therapists, although there is no clear consensus on appropriate management strategy.[25–27] Regional interdependence is an emerging paradigm that encourages a more comprehensive management strategy for individuals with musculoskeletal complaints. Wainner and colleagues[28] described the term regional interdependence as 'seemingly unrelated impairments in a remote anatomical region that may contribute to, or be associated with, the patient's primary complaint'. This approach has been utilized

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in the management of co-existing pathology in the lumbar spine and lower extremities.[8,29] The regional interdependence approach should be considered in individuals with LBP based on the extensive body of literature supporting the anatomical connections and neuromuscular control between the lumbar spine and the hips.[29,30]

Several studies have reported an association between LBP and hip impairments, including limitations in hip internal rotation,[31–35] hip external rotation,[31,32,36] total hip rotation,[31,37] mobility using the flexion–abduction–external rotation (FABER) test, [34,35] and hip flexion.[33] In one study, 48% of older adults with CLBP presented with pain that was reproduced with maximal hip internal rotation and/or the FABER test further implicating the hip in individuals with LBP.[38]

Furthermore, recent work has demonstrated an association between LBP and impairments in neuromuscular control between the hip and lumbopelvic region. Patients with LBP demonstrated less active hip motion and early compensatory lumbopelvic motion, suggesting altered lumbopelvic control and coordination.[30,39]

Several studies also suggest a possible clinical relationship between impairments at the hip and LBP. Sembrano and Polly[40] estimated that the hips may be a contributing pain generator in approximately 12.5% of patients with LBP. In patients with hip osteoarthritis, the presence of LBP has been shown to be associated with a poor prognosis in terms of pain and disability.[41] Finally, radiographic evidence of hip osteoarthritis has been shown to be a risk factor for progression of lumbar disc degeneration[42] and 52–58% of older adults with hip or knee osteoarthritis report concurrent LBP.[41,43]

There is some evidence regarding clinical outcomes for LBP following surgical interventions directed at the hip. The incidence of LBP in patients who have undergone hip fusion has been reported to be 75.8%,[44] almost four times higher than the incidence of LBP reported among a similarly aged cohort.[45] In one study looking at patients receiving total hip arthroplasty (THA), 49% reported LBP, and more than 20% without pre-operative LBP developed post-operative LBP.[46] In 2007, Ben-Galim *et al.*[47] conducted the first clinical study to investigate the direct influence of the hips on the low back. They performed THA procedures on 25 patients with significant concurrent hip and lumbar spine complaints.[47] The patients reported a significant reduction in lumbar disability scores and pain at 3-month follow-up as well as 2 years post-THA. The patients in this study clearly had radiographic signs of moderate to severe hip osteoarthritis, which limits the applicability to a general outpatient physical therapy population. However, it does suggest a dynamic interaction between the hips and the lumbar spine.

Brown *et al.*[48] reported that 81% of patients with LBP that were referred to a specialty spine clinic had hip impairments, but there is a dearth of literature related to physical therapy interventions for LBP directed at impairments of the hip. Two case studies have reported successful management of LBP with interventions addressing impairments of hip motion and hip-lumbopelvic control and coordination.[49,50] Additionally, Di Lorenzo *et al.*[51] studied patients with first time back pain following open reduction internal fixation for extracapsular hip fractures, and found that interventions targeting the hip resulted in a statistically and clinically significant reduction in LBP, whereas interventions targeting the hip and lumbar spine resulted in a greater reduction in LBP.

Clinical decision making can be challenging when patients present with CLBP with concomitant hip impairments.[49] Clinically, we have found that impairment-based manual therapy and exercise for the hips in patients with CLBP can result in noticeable improvements in pain and disability. The aim of the current study was to investigate the response to interventions directed at the hips in a series of patients with CLBP.

Case Description

Patients

Consecutive patients presenting with a chief complaint of chronic LBP (>6 months in duration) were examined for eligibility criteria over a 12-month period (November 2008–2009). Inclusion criteria for this study were a primary report of LBP (between T12 and the gluteal fold) >6 months in duration without radiating pain below the knee, age between 18 and 65 years, a modified Oswestry disability index (ODI) score of ⩾30%, and at least two of the following range of motion (ROM) impairments in one or both hips:

1. prone internal rotation <30°;
2. prone external rotation <30°;
3. supine flexion <110°;
4. prone extension <10°.

Exclusion criteria included any medical red flags that would contraindicate manual therapy to the hips (i.e. tumor, fracture, metabolic disease, rheumatoid arthritis, osteoporosis, and prolonged history of steroid use), previous surgical or non-surgical management within the last 6 months, signs of nerve root compression (i.e. muscle weakness, hyporeflexia, and decreased sensation), fear-avoidance beliefs questionnaire (FABQ) — work subscale score ⩾34, evidence of central nervous system involvement, pending litigation, insufficient English language skills, recently missed menstrual cycle in women, onset of symptoms from a motor vehicle accident, and inability to comply with treatment protocol. This case series was approved by the Colorado Multiple Institutional Review Board at the University of Colorado, Aurora, CO, USA, and the Institutional Review Board at Sacred Heart University, Fairfield, CT, USA.

Outcome measures

Patients completed several self-report measures at the initial, second and final sessions. Paper versions of the outcome measures, provided by the physical therapist, were completed in the waiting room and returned to a front office staff member. Self-report measures collected at baseline included: modified ODI; FABQ — work and physical activity subscales; the patient-specific functional scale (PSFS); and a numeric pain rating scale (NPRS).

The modified ODI is a 10-question condition-specific measurement of pain and disability for individuals with LBP. Each question is scored from 0 to 5 and summed to determine total score, which is the multiplied by 2 and expressed as a percentage. Higher scores correspond to greater disability. The modified ODI has been shown to be reliable and valid in patients with chronic LBP.[52–54] The minimally important clinical difference (MCID) is 6 points or 12% in patients with acute, work-related LBP.[52]

The FABQ is designed to assess the level of fear-avoidance beliefs in patients with LBP, and consists of two subscales relating to such beliefs about work and physical activity.[55,56]

The PSFS is a patient-centered measure that requires the patient to list 3–5 activities that are difficult to perform due to their symptoms, injury, or disorder.[57,58] The patient rates each of the three activities on a 0–10 point scale where 0 is the inability to perform the activity and 10 is able to perform the activity the same as before the onset of symptoms. The final score of the PSFS is derived by averaging the score for each of the three identified activities. The MCID for the PSFS for individuals with chronic LBP has been determined to be 1.4 points and this scale has been shown to be responsive to clinically important change over time.[59]

The NPRS is an 11-point Likert scale ranging from 0 (no pain) to 10 (worst imaginable pain) and was used to assess the patient's level of pain. Each patient was asked to rate the intensity of their current, average, best, and worst pains over the last 24 hours. The average NPRS score was used in reporting results. A two-point change represents the MCID for the NPRS.[56,60,61]

Examination

A detailed history and physical examination was conducted by the treating physical therapist. Eight patients (six male) with an average age of 43.9 years (range: 18–63 years) were enrolled in the study. The standardized history consisted of: social and occupation background; past medical history; history of the current condition (including a body diagram); previous history of LBP; duration and nature of symptoms; and aggravating/relieving factors.

The physical examination consisted of a postural assessment; a neurological screening examination[62] (myotomes, dermatomes, and muscle stretch reflexes); lumbar and hip ROM; accessory motion testing of the thoraco-lumbar spine (T10–L5), pelvis and hips; and assessment of lower extremity, abdominal (including transversus abdominis), and multifidus muscle strength. Details regarding the physical examination can be found elsewhere.[49]

Protocol

Baseline outcome measures and screening for inclusion criteria were performed by the primary physical therapist as part of the examination. Before the initiation of care, informed consent was obtained from each patient who met the eligibility criteria. Each patient consented to treatment directed at their hips initially, and it was explained to the patient that treatment targeting other impairments, including the lumbar spine, would be continued following the cessation of the study. Following the examination, each patient received manual therapy and exercise directed at one or both hip joints (outlined below). The patient returned to the clinic 2–3 days later and received the same interventions. The final visit was 2–3 days later (total of 7–8 days after enrollment) at which time the procedures were repeated. The initial outcome measures were repeated along with the global rating of change (GROC) at visits 2 and 3.[63] The patient was asked to rate their perceived recovery on a scale ranging from -7 (a very great deal worse) to 0 (about the same) to $+7$ (a very great deal better). Jaeschke and colleagues[63] reported that scores on the GROC between ± 1 and ± 3 represent small changes, ± 4–5 represent moderate changes, and ± 6–7 represent large changes in the patients' perceived recovery.

Intervention

Manual therapy

Each patient was examined/re-examined by one of two physical therapists with 4 and 15 years of experience, who worked in outpatient physical therapy settings. All patients received the following interventions: supine long axis distraction thrust manipulation, supine caudal non-thrust manipulation, supine anterior-to-posterior non-thrust manipulation progression, prone posterior-to-anterior non-thrust manipulation in neutral and flexion/abduction/external rotation positions, and mobility exercises targeting the lumbopelvic-hip region. All non-thrust manipulations were performed as grade III or IV oscillations for three

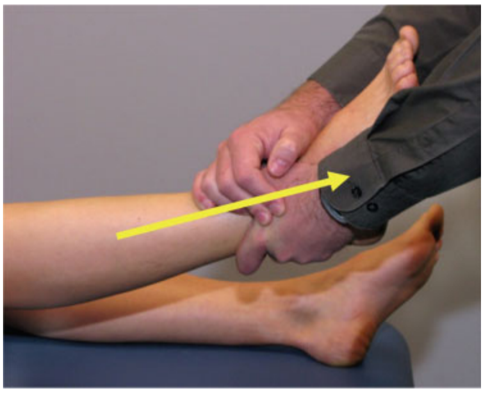

Figure 1 Long-axis distraction manipulation is a high-velocity, end-range, longitudinal traction force to the lower extremity on the acetabulum in supine with the hip in slight flexion, abduction, and varying degrees of internal and external rotation of the lower extremity. Step 1: grasp the patient's ankle proximal to the malleoli with both hands in a grip comfortable for the patient. Step 2: position the leg in approximately 10–30° of hip flexion and 15–30° of abduction, with slight external rotation. Step 3: gently distract the hip and perform oscillations. Step 4: once the hip is felt to relax, apply a high-velocity, small-amplitude thrust.

Figure 3 Anterior–posterior hip mobilization progression is a low-velocity, mid-end-range, anteromedial-to-posterolateral oscillatory force to the femur in a supine position, with hip flexion, adduction, and external rotation. Step 1: position the lower extremity with the hip in a position of flexion, adduction, and internal rotation. Step 2: use your body to impart an oscillatory, passive mobilizing force in a posterolateral direction through the long axis of the femur. Step 3: progress the technique by increasing flexion, adduction, and/or internal rotation.

bouts of 30 seconds.[64] All patients were also instructed to perform mobility and stretching exercises (described below) twice daily as a home exercise program. At each session, interventions were provided in the standardized order outlined above. All interventions are described in Figs. 1–5.

Home exercise program

The therapist selected two out of four potential exercises based on patient-specific physical examination findings. Four exercises were provided and included a kneeling iliopsoas stretch, kneeling hip internal rotation stretch, supine piriformis stretch, and a prone hip 'FABER' stretch. The two exercises were chosen by the therapist based on the primary ROM impairments and/or patient response. Only two exercises were selected to maximize adherence.[65] Each subject was instructed to perform two sets of 30-second holds for each exercise, twice daily.

Outcomes

A total of 41 patients with chronic LBP were screened for eligibility criteria. Eight patients satisfied the eligibility requirements and were enrolled in this case series. Of the 33 that did not fulfill the eligibility requirements, four failed to meet the age criteria, 10 did not have at least two hip impairments, six had symptoms distal to the knee, and 13 had a modified ODI score of <30%.

After the three treatment sessions, five (62.5%) of the patients rated their improvement on the GROC as 'moderately better' (+4) or higher. Two patients

Figure 2 Caudal non-thrust manipulation is a low-velocity, mid-end-range, superior-to-inferior oscillatory force to the femur in a supine position, with hip flexed to 90–100°. Step 1: position the patient in supine and passively flex the hip to 90–100° with neutral rotation. Step 2: place your hands on the anterior aspect of the femur near the joint line of the hip. Step 3: gently distract the femur from the acetabulum in the caudal direction and perform oscillations.

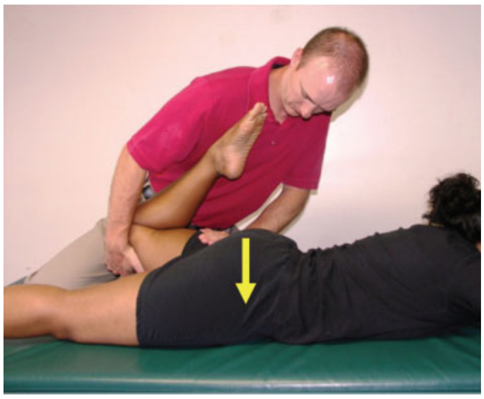

Figure 4 Posterior-to-anterior non-thrust manipulation in neutral is a low-velocity, mid-end-range, posterior-to-anterior oscillatory force to the femur in a prone position. Step 1: position the patient in prone with the knee flexed to 90–100° in neutral abduction and rotation. Step 2: passively extend the hip slightly and apply a posterior to anterior force thru the posterior aspect of the femur slightly distal to the hip.

Figure 5 Posterior-anterior mobilization in flexion, abduction, external rotation is a low-velocity, end-range, posterior-to-anterior oscillatory force to the proximal femur in a prone position, with hip flexion, abduction, and external rotation. Step 1: place the patient in prone. Step 2: bring the hip into varying degrees of flexion, abduction, and external rotation. Step 3: contact the proximal hip and use your body to impart an oscillatory, passive mobilizing force in a posterior-to-anterior direction. Step 4: vary the vector of your mobilizing force dependent on the patient's symptoms and joint stiffness. Step 5: if extremely stiff, start with a pillow under the patient's left trunk to decrease the amount of hip abduction required: progress to lying flat on the table when it is tolerated by the patient.

reported 'no change' on the GROC at the completion of the study. The patients that reported at least 'moderate' improvement for their perceived recovery reported an average reduction of 24.4% on the modified ODI. Three (37.5%) of the patients surpassed the MCID on the modified ODI after the third session. On the NPRS and PSFS, half of the patients reported values that were greater than or equal to the respective MCID. The outcomes for each patient are outlined in Table 1.

Discussion

Manual therapy has been shown to be an effective treatment for individuals with LBP[60,66] and hip osteoarthritis.[67,68] The exact mechanism behind the effectiveness of manual therapy has not been clearly elucidated.[69] The current evidence on the mechanisms suggests the mechanical stimulus of manual therapy may elicit a series of neurophysiological responses involving complex interactions between the peripheral and central nervous systems.[69]

Joint-based manual therapy techniques may exert their effects on both the peripheral and central nervous systems. In the peripheral nervous system, manual therapy has been shown to alter biochemical markers including pro-inflammatory and immunoregulatory cytokines.[70–72]

There may be effects of manual therapy in the central nervous system including the spinal cord and supraspinal structures. At the level of the spinal cord, it has been postulated that joint-based manual therapy increases signal activity from the muscle proprioceptors.[73] Additionally, hypoalgesia and changes in muscle activity following manipulative techniques have been observed.[74–76] George *et al.*[75] performed a lumbar spinal thrust manipulation and observed changes in local hypoalgesia. Fernandez-Carneo *et al.*[74] and Vicenzino *et al.*[76] performed cervical spine thrust manipulation and observed hypoalgesia at the lateral elbow. These two studies indicate that hypoalgesia is possible at a site remote to the manual therapy procedure. At the level of the supraspinal structures, it is theorized that there is facilitation or inhibition of varying signals involved in the regulation of pain.[69] Additionally, joint-based manual therapy may have an effect on psychological outcomes. Williams and colleagues[77] concluded that there were improvements in psychological outcomes following spinal manipulation compared to verbal interventions or other physical interventions.

In the present study, a neurophysiological mechanism may explain, in part, the clinical outcomes in some of our subjects. Over 60% of the patients in this case series reported at least moderate perceived recovery at the end of the study, which may have been modulated by some or all of the components of the previously described neurophysiological mechanism. The relative contribution of peripheral, spinal cord, and supraspinal structures in this study is unknown. The manual therapy package was applied to all patients to potentially 'activate' this mechanism. The home exercise program was designed to

Table 1 Outcomes measures among the eight participants

Subject	Final global rating of change scores	Initial average pain scores	Follow-up average pain scores	Change in average pain scores	Initial PSFS	Final PSFS	Change in PSFS	Initial ODI (%)	Final ODI (%)	Change ODI (%)
1	5	7	5	−2*	2.3	7.7	5.4*	48	42	−6
2	0	7	5	−2*	2.3	2.7	0.4	42	42	0
3	0	7	8	+1	3.6	6	2.4*	62	68	+8
4	4	7	6	−1	4	5	1	38	20	−18*
5	5	7	7	0	4	2.5	−1.5	42	52	+10
6	5	4	2	−2*	4.7	6.7	2*	36	16	−20*
7	3	5	5	0	5.3	6	0.7	40	32	−8
8	5	6	4	−2*	4	6	2*	32	18	−14*

Note: *Values exceeding minimal clinical important difference.

augment the manual therapy techniques in the hopes that any mechanical or neurophysiological changes would be maintained. It may be that the manual therapy and exercise actually had a therapeutic effect on the lumbar spine.

The clinical decision-making process in patients with CLBP can be challenging.[49] Chronic LBP is a complex condition involving both physical and psychosocial variables, and it is often impossible to identify a pathoanatomical source of symptoms.[78] Currently, there is no consensus on the most appropriate management strategies for these patients. Several conservative interventions have been discussed in the literature, including exercise programs,[25,79,80] cognitive behavioral therapy,[81] education,[79] and spinal manipulation;[79,82] however, no single treatment has been shown to be superior.

While no causal relationship can be drawn from our results, this study may assist clinicians in selecting an initial intervention strategy for some patients with chronic LBP with hip ROM impairments. This may be a potential treatment option for patients that are unable to tolerate interventions directed at the lumbar spine initially. When interpreting these results, caution is recommended. There are several limitations with the present study including lack of blinding, no control group, small sample size, and a short-term follow-up. Future research should include well-designed, randomized clinical trials to evaluate the effectiveness of treating hip impairments in patients with chronic LBP. Additionally, future studies should include a longer-term follow-up following this treatment approach.

Conclusion

There are several studies linking LBP with impairments in hip ROM and neuromuscular control; however, there is little clinical evidence investigating the influence or treatment of these impairments. In this study, an impairment-based regional interdependence approach was implemented including manual therapy and exercise directed at impairments at the hip joint. The results suggest that treatment of identified hip impairments could be a viable initial treatment option for patients with a primary report of CLBP. In this case series, 62.5% (five out of eight) of patients with CLBP treated with manual therapy and exercise targeting the hip joints reported their perceived recovery as 'moderately better' and experienced a decrease in disability following these interventions. While the exact mechanism behind this treatment approach is not well understood, a neurophysiological mechanism may be involved. There are several limitations that limit the applicability of the results to larger population and future research should look to clarify the effectiveness and mechanisms behind this approach.

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