Comparative Effectiveness of Straight Leg Raise and Slump Stretching in Subjects with Low Back Pain with Adverse Neural Tension

Neha Malik, Chitra Kataria, Nidhi Bhatia Sachdev

Neha Malik is research student, ISIC Institute of Rehabilitation Sciences, Indian Spinal Injury Centre, New Delhi.

Chitra Kataria , MPT (Orthopeadics), is Principal and Research guide, ISIC Institute of Rehabilitation Sciences, HOD, Rehabilitation Department, Indian Spinal Injury Centre, New Delhi; Research Scholar, Singhania University.

Nidhi Bhatia Sachdev is Physiotherapist and Research Guide, Department of Orthopaedic Physiotherapy, All India Institute of Medical Sciences, New Delhi.

Corresponding Author:

Chitra Kataria

E-mail:
chitrakataria@yahoo.com

Background: Chronic low back pain is a common problem in the present time. It is commonly associated with altered mechanical tension in the peripheral nerves as tested by straight leg raising or slump tests. These maneuvers are used for treatment of such disorders. Both the straight leg raise and slump stretching techniques have been found to be beneficial in the treatment of low back pain with distal symptoms. A comparison of the two techniques will determine if one technique is better than the other. Also, it will add to the evidence for their effectiveness in managing symptoms in patients with low back pain.

Objective: To evaluate the comparative effectiveness of straight leg raise and slump stretching on pain and range of passive straight leg raise in subjects with low back pain.

Methods and measures: 50 patients with low back pain, satisfying the inclusion and exclusion criteria were randomly assigned to three groups. Group 1 was the straight leg raise group (n=15). Group 2 was the slump group (n=13). Group 3 was the control group (n=12). Baseline measurements of pain intensity as measured by the Numeric Pain Rating Scale (NPRS) and range of passive straight leg raise (PSLR) were taken. Group 1 received 6 sessions of straight leg raise stretching and lumbar stabilization exercises. Group 2 received 6 sessions of slump stretching and lumbar stabilization exercises. Group 3 received 6 sessions of lumbar stabilization exercises only.

Statistical analysis: Paired t-test was used for within group analysis of NPRS and PSLR. ANOVA followed by post hoc analysis was employed for between group comparisons.

Results: No significant difference was found in NPRS between straight leg raise and slump groups ($p > 0.05$) while they differed significantly in PSLR ($p < 0.05$). Both the groups showed significantly better results in PSLR when compared to the control group ($P<0.05$). Statistically significant improvements were found in all the 3 groups for both the outcome measures in comparison to the baseline ($p < 0.05$).

Conclusion: From the results of the study, it can be concluded that both straight leg raise and slump stretching are equally effective in reducing pain in patients with low back pain with associated adverse neural tension. Slump stretching is better than straight leg raise stretching in improving the range of passive straight leg raise. Based on patient needs, a treatment program may be formulated using any one or both the techniques. They may be added to conventional treatment protocols as they are better in improving range of passive straight leg raise.

Keywords: Low back pain, Neural mobilization, Straight leg raise, Slump

INTRODUCTION

Low back pain (LBP) is one of the most common health problems in the society. It affects both genders and all ages. About 70% to 85% of population has low back pain at some point in life[1]. Less than one-third of cases resolve annually and more than 20% recur within 6 months. LBP incidences are more recurrent and persistent in older adults[2]. Chronic low back pain is defined by pain persisting for more than 12 weeks[3].

'Neural tension' as a possible source of a variety of signs and symptoms has attracted much attention. Neural tissues are well equipped to tolerate mechanical forces generated during the positions or movements associated with daily and sports activities[4]. Adverse neural tension has been defined as an abnormal physiological or mechanical response produced when structures of the nervous system exceed their normal range of movement[5–7]. Mechanically or chemically sensitized nerves show abnormal mechanosensitivity[8].

Straight leg raising test (SLR) is widely used one of the primary diagnostic physical examination tests in patients who have low back pain or low back and leg pain. Slump test is actually a variant of SLR[9]. These maneuvers and their variants have been used in the treatment of low back and leg pain where straight leg raise and/or slump test were found to be positive in the physical examination.

Neural mobilization techniques are used in the instances of altered neurodynamics or altered neural tension. It aims to restore the relative mobility of the neural tissue and surrounding mechanical interfaces, reducing intrinsic pressures and regaining optimum physiological function[10].

Beneficial physiological effects have been reported as a consequence of these techniques. The neurodynamic techniques have been found to improve neural edema, improve blood flow[11], reduce nociceptive impulses[12] and hypothesized to break down adhesions between the neural tissues and the surrounding connective tissue[7].

Inspite of the knowledge of such benefits, little work is available in the form of RCTs that can give definitive evidence of the benefits of using neurodynamic techniques for back pain population. A recent systematic review identified only 10 RCTs that discussed the therapeutic effect of neural mobilization techniques showing that there was a lack of quality and quantity of evidence for neural mobilization[10].

The purpose of the present study was to compare the effectiveness of slump and straight leg raising in the treatment of low back pain. This RCT was carried out to determine which technique was better in addressing the dysfunctions due to low back pain. A comparison with the control group helped to further strengthen the available evidence on the effectiveness of neural mobilization techniques.

MATERIALS &METHODS

The research work was carried out at the outpatient department of physical therapy of Indian Spinal Injuries Centre.

Subjects

Participants were consecutive patients in primary care between 18 and 60 years of age with a chief complaint of LBP referred to physical therapy. 50 subjects were recruited for the study. 15 subjects in group1, 13 subjects in group 2 and 12 subjects in group 3 completed the study. Patients were required to have symptoms that referred distal to the buttocks, reproduction of the patient's symptoms with straight leg raise testing between 45° to 70°, mild to moderate pain (2 to 6 on NPRS) and a baseline Oswestry score greater than 10%, and an ability to read and understand English. Patients with ''red flags'' for a serious spinal condition (e.g. infection, tumors, osteoporosis, spinal fracture, etc.) were excluded. Individuals who were pregnant, had a history of spinal surgery, positive neurologic signs or symptoms suggestive of nerve root involvement (diminished upper or lower extremity reflexes, sensation to sharp and dull, or strength), osteoporosis, or exhibited a straight leg raise (SLR) test of less than 45°, were also excluded. Inability to hold the slump stretching position, reproduction of symptoms on neck flexion part of slump test also lead to exclusion. Subjects were excluded in presence of Spondylosis, Disc herniation, VBI, Cervicogenic headache. Lumbar spine pathologies like Spondylolisthesis, Spondylolysis, Spinal canal

stenosis were excluded. Spinal deformity (congenital or acquired), Diabetes mellitus, infective or Metabolic polyneuropathy, Ankylosing spondylitis, Systemic cause of backache, were also excluded.

Outcome measures

The 11-point NPRS ranges from 0 (''no pain'') to 10 (''worst pain imaginable'') and was used to indicate the intensity of current pain and at its best and worst level over the last 24 hours[13]. These 3 ratings were averaged to arrive at an overall pain score. The scale has been shown to have adequate reliability, validity, and responsiveness in patients with LBP when the 3 scores are averaged[13].

PSLR was measured using the method described by Hall et al[14]. The subject was supine with arms by the side and one pillow under the head. An inclinometer was strapped on the lateral aspect of the knee joint. Straight leg raise was performed till the first onset of pain (P1). Three measurements of the straight leg raise were taken with modified AFO and knee immobilizer on to standardize the position of knee and ankle (ICC 0.99)[14].

Procedure

Ethical approval for the study was taken at the Indian Spinal Injury Centre, New Delhi in July 2011. Prospective subjects were provided with the details of the purpose and procedure of the study, risks and beneficial effects of the techniques used, the condition of confidentiality, voluntary participation and right to withdraw. They were also given the contact details of the treating therapist. After a duly signed informed consent (with the above mentioned details) was obtained, the participants were screened for inclusion and exclusion criteria. Baseline measurements of all the outcome measurements were taken after randomization of subjects to the three groups. Group 1 received straight leg raise stretching and lumbar stabilization exercises. Group 2 received slump stretching and lumbar stabilization exercises. Group 3 received lumbar stabilization exercises only. All the patients were advised to avoid bed rest and remain active. They were advised to avoid activities that they had typically found to increase their pain. All the patients performed lumbar stabilization exercises (Appendix 1) which was followed by neural mobilization for subjects in group 1 and 2.

Straight leg raise stretching[15]

The subject was supine and relaxed in the center of the bed, with one pillow under the head. The trunk and pelvis was in neutral position. While the therapist was standing beside the affected side and raised the affected side perpendicular to the bed in standard straight leg raise test with one hand placed under the ankle joint and the other hand placed above the knee joints until either pain in the back or referred pain to the leg restricted the movement. Then the lower limb was taken down few degrees from this symptomatic point. The therapist stretched (mobilized) the sciatic nerve by a sequence of gentle oscillations toward ankle dorsiflexion and then reassessed the effect.

The number of these sequences were repeated several times, through which the amplitude of the technique was increased according to the patient response. The technique was progressed to a point where symptoms were where resistance of the movement was encountered. As the pain was relieved, the therapist increased the range of motion until reaching the maximum range of straight leg raise with pain frees. The position was held for 30s.

The Slump stretching [16]

Slump stretching was performed with the patient in the long sitting position with the patient's feet against the wall. The therapist applied over pressure into cervical spine flexion and knee extension to the point where the patient's symptoms were reproduced. The position was held for 30 s.3-5 repetitions of stretches were performed in each session based on patient response.

In case of an adverse response (Appendix 2) to treatment, patients were excluded from the study. The patients attended twice weekly sessions for three weeks. They were instructed to perform the stabilization exercises at home twice a day on the days they did not come for their treatment sessions. After six sessions, final readings of all the outcome measures were taken and the subject was discharged from therapy. Subjects were excluded if they missed any treatment session or reported of not complying with the home program.

Table 1: One way ANOVA for between group comparison of baseline scores

Outcome	Test	Statistic	value	Sig.
Pain (NPRS)	ANOVA	F value	0.049	.785NS
Range of passive straight leg raise (PSLR)	ANOVA	F value	34.318	.066NS

NS indicates non-significant at .05 level

Table 2: One way ANOVA for between group comparison of post intervention scores

Outcome	Test	Statistic	value	Sig.
Pain (NPRS)	ANOVA	F value	0.049	.952NS
Range of passive straight leg raise (PSLR)	ANOVA	F value	34.318	.000*

* indicates p value significant at .05 level, NS indicates non-significant at .05 level

DATA ANALYSIS

Analysis of variance was done at the baseline and at the end of intervention to assess baseline and post intervention between group differences.

When interactions were detected, a post hoc analysis with Bonferroni test was employed. Within group pre and post intervention differences were analyzed using paired t test for each of the outcome measures Statistical significance was set at $P < 0.05$. P value > 0.05 was considered as non significant difference while P value ≤ 0.05 was considered to have represented a significant difference. Value of confidence interval was set at 95%.

RESULTS

Demographic variables reveal no significant difference between the three groups. No baseline differences were found on any of the outcome measures **Table 1**. On analysis of post-intervention scores, significant between group difference was found for range of PSLR. These results are demonstrated in **Table 2**.

Post hoc analysis revealed statistically significant ($P<0.05$) decrease in pain in both straight leg raise and slump groups in pain. No significant difference was found between the straight leg raise and slump groups in their post intervention pain. However, it was noted that the mean reduction in pain scores was higher in the straight leg raise group as compared to the slump group. Post hoc analysis also revealed a significant difference ($P<0.05$) between all the groups for PSLR ($P=.000$) with the maximum improvement shown by the slump group and least by the control group.

DISCUSSION

The present study compares the efficacy of two different neural mobilization techniques (i.e. straight leg raise and slump) and lumbar stabilization exercises for patients with low back pain. Neural tissue mobilization and lumbar stabilization exercises improved the pain and range of passive straight leg raise in patients with low back pain. The results in all the three groups were statistically significant. There was a statistically significant decrease in pain in both straight leg raise and slump groups in pain. A number of physiological benefits have been found with neural mobilization that might be responsible for reducing pain. It is hypothesized that during neural mobilization, in an oscillatory technique like the straight leg stretching in the present study, we are elongating and shortening the nerve which may temporarily increase the intraneural pressure followed by a period of relaxation[11]. This repeated pumping action may enhance dispersal of local inflammatory products in and around the nerve, thus alleviating hypoxia and reducing pain.

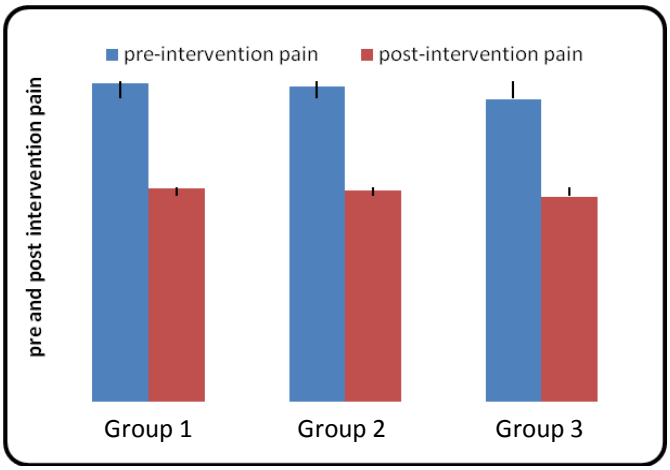

Figure 1:
Between group comparison for pain (NPRS)

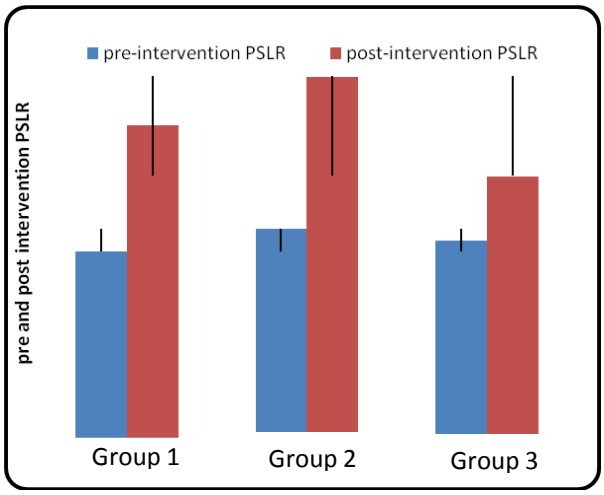

Figure 2:
Between group comparison of range of passive straight leg raise (PSLR)

Brown et al[11] investigated this and found an increase in fluid dispersion in the leg has been found secondary to repeated ankle plantarflexion and dorsiflexion. Dwornik et al[17] quoted that neural mobilization gives high analgesic effects based on the finding that the resting muscle tone decreased post neural mobilization.

Slump stretching has been found to be effective in the treatment of low back pain. It has been hypothesized that it decreases the patient's pain by depressing the intraneural edema[16]. Benecuik et al[12] found that neural tensioning techniques resulted in C-fiber mediated hypoalgesia. The slump stretching has also been associated with inhibitory effects[18] on the sympathetic nervous system, a stimulation of which affects the capability of the nerve to stretch[17]. Slump stretching may also be responsible for reducing scar tissue adhered to the neural tissue and surrounding structures.

No significant difference was found between the straight leg raise and slump groups in their post intervention pain. However, it was noted that the mean reduction in pain scores was higher in the straight leg raise group as compared to the slump group. This is in accordance with Gladsonet al[19] who found that an oscillatory technique was better than the static stretching technique in relieving experimentally induced sciatica.

No significant difference was found in post intervention pain scores when compared to the control group. Although, previous studies have reported a significant pain reduction[15-16]. This may be due to a stringent defining of pain level at the time of inclusion, lack of a home neural stretching program and differences in life styles and activity levels that differs in different places and cultures.

Significant improvements were seen in the straight leg raise and slump groups in the range of passive straight leg raise. Sharma et al[20] reported a significant improvement in the range of straight leg raise following straight leg raise mobilization. This has also been reported by other case studies[21-22]. Effect of slump stretching on range of passive straight leg raise has not been reported previously. However, slump techniques resulted in improved range of knee extension in the slump position[23].

Slump stretching resulted in significantly greater improvements in range of motion when compared to the straight leg raise stretching. Apart from the fact that the slump position maximally tightens the neural tissue as compared to the straight leg raise technique[6]. It effectively stretches the canal/foramen structures for which straight leg raise is often insufficient[6]. Slump mobilization has also been found to affect posterior myofascial chain flexibility thus increasing the

tibio-tarsal joint angle and finger-floor distance which could be another possible mechanism in the greater improvement of range[24].

There is a difference in opinion on the comparative effects of straight leg raise and slump stretching. It was suggested by Maitland that slump technique would be better than straight leg raise in the treatment of lumbar disorders[25]. Hall and Elvey suggested that oscillatory techniques are better than static stretching since static stretching may increase intraneural pressure[19]. At the same time the findings of various studies cannot be ignored where static stretching techniques have resulted in decreased pain. In the present study, no difference has been found between the two techniques, however, further research is required before reaching a conclusion.

CLINICAL RELEVANCE OF THE STUDY

The results of the present study favour the use of neural mobilization techniques in the treatment of low back pain with associated altered neurodynamics. Both the straight leg raise and slump techniques have equal effectiveness in treating patients with low back pain. Therefore, a treatment program may be formulated using any one or both the techniques.

LIMITATIONS OF THE STUDY

Limited number of subjects and lack of long-term follow up is a limitation. There is a wide variation in the age of the subjects included in the study. Also, subjects from all professions and thus different activity levels were included and may be a source of variation in results.

FUTURE RESEARCH

A study with large number of subjects should be carried out to confirm the results of the present study. Neural mobilization techniques can be used and studied for specific pathologies like disc herniation, canal stenosis, spondylosis and more. Variations of straight leg raise and slump techniques can be studied for their effectiveness in low back pain. Dosage based response should be studied as no fixed dosage has been recommended in the literature.

CONCLUSION

From the results of the study, it can be concluded that both straight leg raise and slump stretching are equally effective in reducing pain in patients with low back pain with associated adverse neural tension. Slump stretching is better than straight leg raise stretching in improving the range of passive straight leg raise.

REFERENCES

1. Andersson GBJ. Epidemiological features of chronic low-back pain. Lancet 1999; 354:581-85
2. Cassidy JD, Côté P, Caroll L J, Kristman V. Incidence and course of low back pain episodes in the general population. Spine 2005; 30:2817-2823
3. Koes BW, Van Tulder MW, Peul WC. Diagnosis and treatment of sciatica. BMJ June 2006; 332:1430-1431
4. Nee RJ, Butler DS. Management of peripheral neuropathic pain: Integrating neurobiology, neurodynamics and clinical evidence. Physical Therapy in Sport 2006; 7:36-49
5. Breig A. Adverse Mechanical Tension in the Central Nervous System, an analysis of cause and effect. Almqvist&Wiksell International. 1978
6. Butler DS. Mobilization of the Nervous System. Churchill Livingstone, 1991
7. Turl SE, George KP. Adverse neural tension: A factor in repetitive hamstring strain? Journal of orthopaedic and sports physical therapy 1998; 27(1):16-21
8. Butler DS. Adverse Mechanical Tension in the Nervous System: A model for assessment and treatment. The Australian Journal of Physiotherapy. 1989; 35(4):227-238
9. Majlesi J, Togay H, Ünalan H, Toprak S. The sensitivity and specificity of the slump and the straight leg raising tests in patients with lumbar disc herniation. Journal of clinical rheumatology April 2008; 14(2):87-91
10. Ellis RF, Hing WA. Neural mobilization: A systematic review of randomized controlled trials with an analysis of therapeutic efficacy. Journal of Manual and Manipulative Therapy. 2008; 16(1):8-22

11. Brown CL, Gilbert KK, Brismee JM, Sizer PS, James CR, smith MP et al. The effects of neurodynamic mobilization on fluid dispersion within the tibial nerve at the ankle: an unembalmed cadaveric study, Journal of Manual & Manipulative Therapy, 19 (12011): 26-34(9)
12. Beneciuk JM, Bishop MD, George SZ. Effects of upper extremity neural mobilization on thermal pain sensitivity: a sham-controlled study in asymptomatic partiocipants. Journal of orthopaedic and sports physical therapy 39(6):428-438
13. Childs JD, Fritz JM, Flynn TW, Irrgang JJ, Johnson KK, Majkowski GR, Delitto A: A clinical prediction rule to identify patients likely to benefit from spinal manipulation: a validation study. Annals of Internal Medicine 2004; 141:920–8.
14. Hall T, Beyerlein C, Hansson U, Lim HT, Odermark M, Sainsbury D. Mulligan traction straight leg raise: A pilot study to investigate the effects on range of motion in patients with low back pain. The Journal of Manual and Manipulative Therapy. 2006; 14(2):95-100
15. Adel SM. Efficacy of neural mobilization in treatment of low back dysfunction. Journal of American Science. 2011; 7(4):566-573
16. Cleland JA, Childs JD, Palmer JA, Eberhart S. Slump stretching in the management of non-radicular low back pain: A pilot clinical trial. Manual Therapy. 2006; 11:279-286
17. Dwornik M, Kujawa J, Bialoszewski D, Slupik A, Kiebzak W. Electromyographic and clinical evaluation of the efficacy of neuromobilization in patients with low back pain. Ortopediatraumatologiarehabilitacja 2009; 2(6); 11:164-176
18. Cleland J, Durall C, Seoll SA. Effects of slump long sitting on sudomotor and vasomotor function: a pilot study. Journal of manual and manipulative therapy 2002; 10(2):67-75
19. Gladson GR, Silva TS, Trindade DL, Ciena AP, Carvajho AH. Neural mobilization and static stretching in an experimental sciatica model – an experimental study; RevistaBrasileira de Fisioterapia, 2009;13(6):493-8
20. Sharma V, Sarkari E, Multani NK. Efficacy of neural mobilization in sciatica. Indian journal of physiotherapy and occupational therapy 2011; 5(1):125-127
21. Balla J, George SZ. The use of a modified treatment based classification system to treat an adolescent with imaging evidence of a herniated disc. Orthopaedic practice 20;3:08 176-181
22. Koury MJ, Scarpelli E. a manual therapy approach to evaluation and treatment of a patient with a chronic lumbar nerve root irritation; Physical Therapy I994; 74:548-560
23. Herrington L. Effect of two different neurodynamic mobilization techniques on knee extension range of motion in the slump position, The Journal of Manual and Manipulative Therapy 2006; 14(2):101-107
24. Diniz KT, Mironda RM, Ribeiro CD, Vasconcelos DA, FilhoJEC . Neural mobilization Effects in posterior myofascial chain flexibility and in head posture. Neurobiologia 2010; 73(3): 53-57
25. Maitland GD. The slump test: Examination and Treatment. Australian journal of physiotherapy 1985; 31(6):215-219
26. Richardson C, Jull G, Hodges P. Therapeutic exercise for spinal segmental stabilization in low back pain. Scientific basis and clinical approach. Churchill Livingstone. 1999
27. Kisner C, Colby L. Therapeutic exercise: Foundations and techniques. 5th edition.
28. Bakhtiary AH, Farokhi ZS, Rezasoltani A. Lumbar stabilization exercises improve activities of daily living in patients with lumbar disc herniation. Journal of back and musculoskeletal rehabilitation. 2005; 18(3-4):55-60

APPENDIX 1

LUMBAR STABILIZATION EXERCISES[26–28]

All the subjects were trained to contract lumbar multifidus and transversusabdominis in hook-lying and prone positions. The exercises were progressed with two exercises added to the lumbar stabilization program per week.

Week 1

- Patient position: four-point kneeling with the spine in neutral position
  Patient instruction: Relax, breath in and breath out, slowly pull your navel up and in towards your back bone, hold the contraction and breath.
  Dosage: 10 seconds hold and 10 repetitions
- Patient position: hook-lying
  Patient instruction: relax, breath in and breath out, slowly and gently, draw in your lower abdomen, hold the contraction and breath. Slide your one leg along the mat to straighten the knee and return to the starting position. Do not release your abdominal contraction during the exercise. Relax. Repeat the same procedure with your other leg.
  Dosage: 10 repetitions on each leg

Week 2

- Patient position: hook-lying
  Patient instruction: Relax, breath in and breath out, slowly and gently, draw in your lower abdomen, hold the contraction and breathe. Squeeze your buttocks together and lift your pelvis up. Do not release your abdominal contraction during the exercise. Hold this position for 5-10 seconds. Lower your pelvis. Relax.
  Dosage: 5-10 seconds hold and 10 repetitions

- Patient position: hook-lying
  Patient instruction: Relax, breath in and breath out, slowly and gently, draw in your lower abdomen, hold the contraction and breathe. Lift one leg up without bending the knee upto approximately 45°. Do not release your abdominal contraction during the exercise. Hold the position for 5-10 seconds. Lower the leg. Relax. Repeat with your other leg.
  Dosage: 5-10 seconds hold and 10 repetitions

Week 3

- Patient position: four-point kneeling with the spine in neutral position
  Patient instruction: Relax, breath in and breath out, slowly pull your navel up and in towards your back bone, hold the contraction and breath. Slowly raise your one leg up with the knee straight followed by the opposite arm without bending the elbow. Do not release your abdominal contraction during the exercise. Hold this position for 5-10 seconds. Lower your arm and leg. Relax. Repeat with the other diagonal leg and arm.
  Dosage: 5-10 seconds hold and 10 repetitions with each diagonal
- Patient position: prone with a pillow under the abdomen.
  Patient instruction: Relax, breath in and breath out, slowly pull your navel up and in towards your back bone, hold the contraction and breath. Slowly raise both your legs up straight without bending your knees. Do not release your abdominal contraction during the exercise. Hold this position for 5-10 seconds. Lower your legs. Relax.
  Dosage: 5-10 seconds hold and 10 repetitions
- Patient position: prone with a pillow under the abdomen.
  Patient instruction: Relax, breath in and breath out, slowly pull your navel up and in towards your back bone, hold the contraction and breath. Slowly raise both your arms up straight without bending your elbows. Do not release your abdominal contraction during the exercise. Hold this position for 5-10 seconds. Lower your arms. Relax.
  Dosage: 5-10 seconds hold and 10 repetitions

APPENDIX 2

Adverse response to treatment[6]

- Dull constant ache with stretching
- Pain or paraesthesia that persisted even minutes or hours after the treatment session greater than the previously reported intensity.
- Peripheralization of symptoms
- Any paraesthesia occurred that was not previously present