Efficacy of Unilateral Z - joint Mobilization on Posterior Chain Neurodynamics

Surendra K. Wani[1#], Khan Rakshanda[2], Sunita D. Chavan[3*]

[1]Assistant Professor, [2,3]MPTH

Department of Musculoskeletal Physiotherapy, MGM's School of Physiotherapy, N-6 CIDCO Aurangabad, Maharashtra, INDIA.

Corresponding Addresses:

[#]suren_wani@yahoo.com, [*]dcsoni04@gmail.com

Research Article

***Abstract*: Aim of the study:** To study the efficacy of Z joint mobilization on bilateral posterior chain neurodynamics. **Methodology:** 50 healthy participants with hamstring tightness with bilateral passive SLR < 70 degrees were included in the study. 5 sessions of Grade 3 oscillatory PA mobilizations were given unilaterally at a frequency of 2 Hz to the T12/L1, L1/L2, L2/L3, L4/L5 and L5/S1 Z-joints for 30 s per joint (3 min total treatment) on the side of dominant leg. Pre and post intervention SLR measurements were noted. **Results:** On comparison between pre and post SLR measurement using paired 't' test, a significant difference between baseline and post-intervention for the unilateral mobilization ($p<0.001$) was found. In the present study there was increase in the SLR measurement by 23.84% on ipsilateral side and 12.86% on contra lateral side. **Conclusion:** This study concluded that unilateral lumbar Z joint mobilization is effective in increasing SLR range on ipsilateral as well as contralateral side.

Key words: Posterior chain neurodynamics, hamstring strain, zygapophyseal joint mobilization.

Introduction

"Posterior chain" refers to muscles and neural structures of the posterior hip, thigh and lower leg [1]. Neurodynamics is the term used to describe the Integrated morphological, biomechanical and physiological functions of the nervous system [2,4]. Abnormal neurodynamics is one factor that could influence both hamstring muscle length as well as lumbopelvic biomechanics , i.e. posterior chain neurodynamics leading to various musculoskeletal injuries [5]. Hence length of muscle tissue is thought to play an important role in the effectiveness and efficacy of human movement. Muscle tightness is the most common disorder in normal healthy individuals. Shortened muscle form a major element of this condition and restricted flexibility is the key element and a contributing factor in sport related injuries, lumbar spine disorder and general low back pain [6]. Biomechanically the synchronization between the joints is a complicated proprioceptive and mechanical problem. This is complicated further when muscle units cross both joints. Muscle which have not been trained to employ their full amplitude, may fall when required to pass through their full amplitude under rapid and stressful situation [7]. The alteration of the normal relationship among the alignment of the spine, the position of the pelvis and the length of the muscle attaching to the spine and pelvis contributed to development of LBP in hamstring tightness [8]. The human posture is determined by muscular chains, fascias, ligaments, and bone structure, which are connected and comprise the whole organism. Any modification in each of these structures can lead to a postural disequilibrium; some initial tension can cause a sequence of combined tension [9]. According to Butler, tension in muscular chains may cause or may be caused by irregular mechanical and physiological responses in the nervous systems, resulting in alterations of the elasticity and amplitude of movements [10]. Considering that the nervous system is a continuous tissue that adapts itself to the body movements, this adaptability can be transmitted to the whole body system. Therefore, any alteration that modifies its structure may be transmitted throughout it and even result in dysfunctions in musculoskeletal structures which receive innervations. The neural mobilization causes the return of the normal functions since it is a technique that restores the movement and elasticity of the nervous system [4]. When neural mobilization is used in the treatment, its main purpose is to reestablish the dynamic equilibrium of the neural tissues, normalizing its physiologic function [11-13]. According to the study done by Turl and George in 1998 suggest that posterior chain muscle injury presents clinically with abnormal neurodynamics in the nerves that innervate those muscles, preliminary research has suggested that neural mobilization exercises could reduce the rate of re-injury. In addition to this, in a recent study done by Adam *et al.* found that grade III mobilizations (large amplitude movement moving into resistance) delivered unilaterally to lumbar spine Z-joints at a frequency of 2Hz induces sympathetic nervous system (SNS) changes (determined by measuring skin conductance) in the lower limb in a manner specific to the side of the spine receiving treatment i.e. on ipsilateral side

by immediately restoring posterior chain neurodynamics [14].

Because of the very limited researches in the field's literature and considering the relation between neural connective tissue and underlying tissue, the main aim of this research is to evaluate the effect of unilateral lumbar Z-joint spinal mobilization on ipsilateral and contralateral posterior chain neurodynamics. In clinical perspective it is important which may allow the therapist to physically treat the non-painful part of patient's body while achieving treatment effect on contra lateral painful side.

Materials and methods

Before implementing the study, an approval from college ethical committee was taken. Patients were explained the procedure and duration of study and verbal and written consent were taken. 109 normal healthy individuals were screened for bilateral PSLR < 70 degrees after doing the intra-rater and inter-rater reliability for measurement of PSLR using half circle goniometer. Out of which 50 participants fulfilling the inclusion criteria both genders, age group between 18-40 years with bilateral passive SLR <70 degrees were included in the study. Rest of the participants were excluded because of not willingness and met exclusion criteria like elite athletes, previous and past injuries to spine and lower limb, any history of spinal injury or history of back injury.

Intervention

Two investigators were needed for the study. Researcher 1 (investigator) applied the intervention. Researcher 2 assessed the outcome measures with the help of assistant.

Intervention was performed in private room, only Researcher 1 was to be present there, thus blinding of Researcher 2 for intervention be taken and to which side intervention has been given.

Starting position

The participant lied prone with arms beside, and his/her head turned to the side. If technique was to be performed on the left side of the spine, the therapist stood by the patient's left side and placed her thumbs on participants zygopophyseal joint ,pointing towards each other, immediately one finger breadth distance in between interspinous spaces on left side or the side to be treated. It is wise not to reinforce one thumb with other, as this destroys the feel that can be obtained through the pad of the thumb. The fingers were spread around the thumbs to provide stability. The base of the thumb was brought as near directly above the tip of the thumb as possible. This position was governed by the ability to hyperextend the thumbs. (Fig. 1)

Procedure for Lumbar zygopophyseal joint mobilization

Researcher 1 positioned her shoulders above her hands, and transmitted the pressure of her trunk through her arms to her thumbs. The thumbs act as springs as the pressure is applied, and in no way do the thumb flexors act as prime movers. Unilateral Grade III oscillatory PA mobilizations were given at a frequency of 2 Hz to the T12/L1, L1/L2, L2/L3, L3/L4, L4/L5 and L5/S1 Z-joints for 30 s per joint (3 min total treatment) on the side of dominant leg irrespective of range of PSLR for 5 sessions for 5 days.

Figure 1: Showing the Zygopophyseal Joint Mobilization

Outcome Measure

Passive Straight Leg Raise Test- (Fig. 2)

It is a valid test for measuring changes in posterior chain neurodynamics [15].

Method: Participants were positioned in supine on the treatment plinth in the standardized position. Researcher 2 raised the dominant limb into hip flexion with ankle plantar grade and movement was controlled in sagittal plane. Limb movement was being stopped at R1 as detected by researcher 2. R1 was thought to represent protective muscle spasm in posterior chain muscle due to increase in neural stress induced due to the position of the ankle in plantar grade. Angle of SLR was measured by researcher 2 with their assistant by using the half circle goniometer, this was repeated 3 times and average of these 3 readings was taken, this test was performed bilaterally. SLR < 70 degrees is included in the study.

Figure 2: Showing the SLR measurement

Result and Statistical Analysis

In the present study there was increase in the SLR measurement by 23.84% on ipsilateral side and 12.86% on contra lateral side. [Table I, II and III] Statistical analysis for the present study was done manually as well as using the statistics software SPSS 13 version so as to verify the results obtained. Nominal data in the form of participant's demographic data i.e. age were analyzed using mean and standard deviation. Intra group

comparison of the pre interventional and post interventional outcome measures was done by using student paired 't' test. Probability values less than 0.05 were considered statistically significant and probability values less than 0.0001 were considered highly significant. The results were analyzed in terms of increase range of SLR which was measured by using universal half circle goniometer. Intra group comparison has been done so as to evaluate the efficacy of the treatment protocol under consideration in the present study.

Table 1: Age and Gender wise Distribution

Gender	Mobilization Group	%	Mean ±SD of Age (years)
Male	15	30	23.8 ± 2.902
Female	35	70	22.08±2.102
Total	50	100	22.6±2.498

Table 2: Comparison of Pre and Post intervention of Rt side by using paired 't' test.

Outcome Measure	Rt Pre Mean ±SD	Rt Post Mean ±SD	Degrees of freedom	95% CI		SEM		'P' value	Inference
PSLR	43.28±10	53.6±8.48	49	UL 11.72	LL 8.92	Rt Pre 1.41	Rt Post 1.2	<0.0001	Highly Significant

Table 3: Comparison of Pre and Post intervention of Lt side by using paired 't' test

Outcome Measure	Rt Pre Mean ±SD	Rt Post Mean ±SD	Degrees of freedom	95% CI		SEM		'P' value	Inference
PSLR	47.12±10.15	53.18±9.02	49	UL 7.55	LL 4.57	Lt Pre 1.44	Lt Post 1.28	<0.0001	Highly significant

Discussion

The aim of the study was to find the efficacy of unilateral Z- joint mobilization on bilateral posterior chain neurodynamics. The results of this study showed that unilaterally applied grade III oscillatory PA-mobilizations to all lumbar Z-joints resulted in an significant increase in post interventional mean SLR measurement on the ipsilateral as well as contra lateral side to the treated Z-joints, when compared with the pre-interventional . This result was in accordance to the recent findings of most likely reflects a change in posterior chain neurodynamics ipsilaterally [15]. The use of neural tension tests that is SLR used in present study is a major part of the mobilization of the nervous system. The aim of using these tests in assessment is to stimulate mechanically and move neural tissues in order to gain an impression of their mobility and sensitivity to mechanical stresses. In the presence of abnormality, the purpose of treatment via these tests is to improve their mechanical and physiological function [2-4]. Maitland who implies that large amplitude oscillations are more effective in reducing pain [48]. One of the study established that a hypoalgesic response is elicited from lumbar PA mobilizations regardless of amplitude. The results of that study showed that there was not only a statistically significant local effect, decrease in pressure pain threshold sites but also a significant systemic effect. This is in contrast to studies that demonstrated unilateral cervical spinal mobilizations had a significant side specific response and not a bilateral effect [49,14]. It has been suggested that activation of descending inhibitory pathways would be expected to produce a widespread hypoalgesic response that would include areas away from the site treated with mobilization [50].

In the present study unilaterally applied grade III oscillatory PA mobilizations over lumbar Z-joints of the dominant leg resulted in statistically significant increase in bilateral SLR measurement post interventionally. There was increase in the SLR measurement by 23.84% on ipsilateral side and 12.86% on contra lateral side. Spinal mobilization on ipsilateral side produces a sympathetic nervous system (SNS) response demonstrated by many proxy measures but mostly SC and ST, then this SNS response must be because the dorsal peri-aqueductal (dPAG) matter of the midbrain is stimulated. Stimulation of the dPAG produces analgesia, sympatho-excitation, and motor facilitation [51]. The current study seems supported by the findings of indicate that unilaterally applied mobilizations cause an immediate increase in SLR, ipsilateral to the side treated [1]. It has been shown that both spinal manipulation with thrust and spinal mobilization without thrust, induced transient alpha motor neuron inhibition in the motor neuron pool (tibial nerve region) supplied by the treated spinal segments and there was increase in SLR post mobilization intervention, and that such effects have been shown by electromyography to correspond with decreased posterior chain muscle activity [15]. But we did not find the cause and supporting literature that why there is increase in SLR range on contra lateral side. The mechanism of action for the measured increase in contra lateral SLR by giving

mobilization on ipsilateral side is currently unknown. Investigation into the mechanism of spinal mobilization affecting SLR, and potentially neurodynamics, was beyond the scope of this study, however research into this area is recommended. Added studies in the future should then research the role of spinal mobilization techniques for treating abnormal neurodynamics in athletic populations, specifically in relation to hamstring strain prevention and recovery

Conclusion

Unilaterally applied grade III oscillatory PA-mobilizations to lumbar zygopophyseal joint causes an increase in SLR on ipsilateral as well as contra lateral side. This outcome likely reflects a change in bilateral posterior chain neurodynamics

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