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Effect of Proprioceptive Neuromuscular Facilitation Stretching (Modified Hold-Relax) on Hamstring Flexibility In subjects Having Chronic Low Back Pain

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Abstract: ***Low back pain(LBP) is among the leading cause of occupational injury and disability in both developed and developing countries. Sedentary life style is associated with obesity as well as muscle shortening, which in turn is linked to chronic health problems. Among all these factors the hamstring tightness was found to be one of the leading causes for development of LBP. Proprioceptive Neuromuscular Facilitation (PNF Modified hold-relax) works on Autogenic inhibition to improve the hamstrings flexibility. 15 subjects were taken in the study. Measurement of the severity of pain by using VAS, degree of hamstrings tightness by active knee extension test and functional disability by modified oswestry disability index was done. The main findings of the present study were that 10 sessions of PNF significantly reduce mean hamstrings tightness (t=4.821, p<0.001), pain at rest (t=4.83, p<0.001), pain on activity (Z = -3.296, p=0.001) & functional disability (Z=-3.302,p<0.001). Proprioceptive Neuromuscular Facilitation (PNF Modified hold-relax) improves hamstrings flexibility and reduce pain and disability.***

Keywords: Chronic Low back pain, *Proprioceptive Neuromuscular Facilitation stretching*, H*amstrings flexibility*, Active knee extension test

1. Introduction

Chronic low back pain (CLBP) is defined as back pain lasting more than 12 weeks [1]. A previous history of low back pain is often predictive of future back problems [2], and chronic cases represent a significant burden on the health care and compensation systems[3]. Low back pain is a significant public health problem in all industrial nations. It is associated with considerable disability, health problems and social cost. [4]

There are several factors which are responsible for development of LBP. They include increased lumber lordosis, reduced abdominal muscle length and strength, decreased back extensor muscle endurance, back extensor muscle flexibility, length of iliopsoas, hamstring muscle flexibility, body composition[5],[6],[7],[8]etc. Controversies exist regarding association between various physical characteristics and the occurrence of LBP.

In contextual concept of International Classification of Functioning (ICF) Model, both environmental and individual factors affect the development of low back pain. Lifestyle is a factor that could affect individual's health (WHO2001). Sedentary life style is associated with obesity as well as muscle shortening, which in turn is linked to chronic health problems.[9] Among all these factors the hamstring tightness was found to be one of the leading causes for development of LBP.

Hamstring tightness is the inability to stretch the muscle through full range of motion. Hamstrings are a prime mover and stabilizer of the body that contains muscle spindle, as its functional unit and golgi tendon organs which play an important role in determining the length and function of the muscular components. Hamstrings are an example of a muscle group that has a tendency to shorten [10].

Hamstrings are the long and powerful group of muscles that span the back of the thigh [11]. As hamstrings muscles are the joining source between the lower back region and the posterior part of thigh, reduced hamstrings extensibility draws the pelvis into posterior rotation during normal daily postures. It develops alterations in the lumbar curve and changes the biomechanical line of pull of back and strains the back during usual day to day activity [12]. So thereby it causes compensatory movement patterns in the lumbar spine and subsequently increased stress on the lumbar spine and subsequently increased stress on spinal soft tissues and increased likely hood of injury to the spine.[13] Therefore, poor hamstring extensibility has been associated with thoracic kyphosis, spondylolysis, disc herniation, changes in lumbopelvic rhythm and low back pain.[14] Additionally, individuals with shortened hamstring muscles present gait limitations, increased risk of falls, and susceptibility to musculoskeletal injuries[10].

Different stretching methods which are used to increase hamstrings flexibility are active stretching, passive stretching, ballistic stretching, static stretching, dynamic stretching, Muscle energy technique, Bowen technique, Dynamic soft tissue mobilization, massage therapy, walking exercise, bicycling, water therapy, active release technique (ART), and proprioceptive neuromuscular facilitation (PNF).[14],[15],[16].

Proprioceptive neuromuscular facilitation (PNF) is a type of technique that combines passive stretching and isometric stretching in order to achieve maximum static flexibility. PNF usually employs a resistance against an isometric

contraction followed by passively taking the muscle group through an increased range of motion.[15] Multiple forms of PNF exist and include the hold-relax technique, the hold-relax-contract technique and the hold-relax-swing technique. PNF ultimately helps train the stretch receptors of the muscle spindle to immediately accommodate a greater muscle length and subsequently, a new, increased flexible length of muscle. Although research and clinical experience has shown that treatment of hamstring flexibility is important, there is no widely acceptable form of treatment that is agreed upon to successfully improve flexibility of hamstrings which may indirectly affect the back region. So arises the need of the study.

2. Materials and Methodology

Quasi Experimental Study was conducted. 15 subjects were included in the study at department of physiotherapy, General hospital. 10 sessions of PNF (Modified Hold- relax) over a period of 6 months were given.

Inclusion criteria

- Males and females, Age between 20 to 60 years.
- Subjects having chronic low back pain (more than 3 months) of mild-moderate intensity.
- Subjects not involved in any flexibility exercise program.
- Subjects having popliteal angle<160°.
- Subjects willing to participate.
- Subjects who were able to comprehend the commands.

Exclusion criteria:

- Medical history of injury to back, constant or persistent severe pain.
- Inflammatory conditions (rheumatoid arthritis, ankylosing spondylitis).
- Spinal infections(neuralgia, discitis, osteomylitis, epidural abscess)
- Hamstrings injury and strains.
- Knee deformities and injuries.
- Any impaired sensations and other neurological conditions.
- Athletes.
- Any previous surgery around the knee and hip.
- Pregnancy.
- Patients having radiating pain.
- Any venous thrombosis and arterial disease.

Material used:

- Goniometer
- Data collection sheet
- Consent form
- Plinth, Stool
- Pen
- Questionnaire
- Hot packs

Outcome Measures

1. Active Knee Extension Test
2. Modified Oswestry Disability Index
3. Visual Analogue Scale

Procedure:

Ethics approval was obtained from the institutional review board. Patients with chronic low back pain with hamstrings tightness referred to physiotherapy department by orthopedic department of general hospital were screened to find their suitability as per the inclusion and exclusion criteria. They were briefly stated about the nature of the study and intervention and written consent was taken from them. Demographic and baseline data were taken including history, occupation, duration of pain etc. Measurement of the severity of pain, degree of hamstrings tightness and functional disability was done.

Severity of pain:

Pain intensity was measured using visual analogue scale (vas). The vas consists of a 10-cm line, with the left extremity indicating ‘‘no pain’’ and the right extremity indicating ‘‘unbearable pain.’’ participants were asked to use the scale to indicate their current level of pain. Higher values suggest more intense pain.

Active knee extension test:

Subjects were assessed for hamstring tightness using the active knee extension (AKE) test (popliteal angle). [17] The subjects were in supine position with the hip flexed to 90 degrees and knee flexed. The testing was done on the right lower extremity first and subsequently on the left lower extremity. The fulcrum of the goniometer was centered over the lateral condyle of the femur. The proximal arm was aligned with the long axis of femur using greater trochanter as a reference. The distal arm was aligned with the lower leg using the lateral malleolus as a reference. The subject was then asked to extend the lower extremity as far as possible until a mild stretch was felt. Three repetitions were performed and an average of the three was taken as final reading of popliteal angle in degrees.

Functional disability:

Functional disability was estimated by the Modified Oswestry Disability Index (MODI). This questionnaire is designed to enable us to know how much the low back pain has affected patient’s ability to manage his everyday activities. Patient has to answer each section by marking a circle on the statement which most closely describes his problem. The score is calculated by the addition of the values assigned for each of the 10 individual questions and is used to categorize disability as: mild or no disability (0-20%); moderate disability (21%-40%); severe disability (41% to 60%); incapacity (61% to 80%); restricted to bed (81% to100).[18],[19], [13].

PNF (Modified Hold Relax)

All 15 subjects were given PNF (modified hold-relax)The modified hold - relax stretch was performed with subjects in supine position with hip 90 degrees flexed with no hip rotation. The therapist passively stretched the hamstrings, until the subject first reported mild stretch sensation and held that position for 7 seconds. Then the patients were instructed to perform a maximum isometric contraction of the hamstring for 7 seconds by attempting to push his leg back towards the table against the resistance of therapist. After the contraction, a 5 second rest period was given to the patient. The therapist then passively stretched the hamstrings

until a mild sensation was again reported. The stretch was maintained for another 7 seconds. This sequence was repeated 3 times in a session and given for 10 sessions. All the patients were given isometric abdominal exercises, isometric extensor exercises and hot packs for low back region.

Outcome measures were taken at the end of 10 sessions i.e after completion of the study duration which included VAS, MODI and Active knee extension test.

Mean VAS scores pre & post treatment

Outcome measures	*Pre-treatment*		*Post-treatment*		*t/Z value*	*p-value*
	Mean	SD	Mean	SD		
VAS (Rest)	2.55	1.87	1.12	1.05	t=4.83	<0.001
VAS (Activity)	7.89	2.75	3.64	1.92	Z=-3.296	0.001

Mean VAS (at rest) Within group analysis of difference in mean of pre and post VAS at rest was done using Paired t-test (t=4.83, p<0.001). So the difference is statistically significant

Mean VAS (at activity). VAS at activity was done using Wilcoxon matched paired signed rank test (Z=-3.296, p<0.001, was found to be statistically significant.

Median MODI

Outcome measures	*Pre-treatment*	*Post-treatment*	*Z-value*	*p-value*
MODI	30	10	-3.302	0.001

3. Result

Statistical analysis was done using SPSS version 16 and Microsoft excel 2007. The data was screened for normal distribution using Kolmogorov Smirnov normality test and histogram with normal curve. Within group analysis was done using outcome measures taken before the intervention

Within group analysis of difference in median scores of MODI was done using Wilcoxon matched pairs signed rank test. (Z=-3.302),p=0.001 was found to be statistically significant.

Outcome measures	*Pre-treatment*		*Post-treatment*		*t-value*	*p-value*
	Mean	*SD*	*Mean*	*SD*		
AKE(Rt) (degrees)	138.30	6.60	149.25	6.96	5.446	<0.001
AKE(Lt) (degrees)	143.25	5.09	149.99	7.08	3.264	0.006
AKE (Mean)(Degrees)	140.78	5.31	149.62	5.80	4.821	<0.001

Mean Active knee extension test scores pre & post treatment (Right, Left and Mean of right and left)

Mean Active knee extension test (Rt) Within group analysis of difference in mean of pre and post AKE (Rt) was done using Paired t-test(t=5.446, p<0.001). p<0.05 was found to be statistically significant.

Mean Active knee extension test (Lt) Within group analysis of difference in mean of pre and post AKE (Lt) was done using paired t-test. (t=3.264, p=0.006) , was not found to be statistically significant.

Mean Active knee extension test (Mean of Rt and Lt) Within group analysis of difference in mean of pre and post AKE (Mean) was done using Paired t-test. t=4.821, p<0.001) So p<0.05 was found to be statistically significant.

4. Discussion

The main findings of the present study are that 10 sessions of PNF significantly reduces mean hamstrings tightness (t=4.821, p<0.001), pain at rest (t=4.83, p<0.001), pain on activity (Z = -3.296, p=0.001) & functional disability (Z=-3.302, p<0.001).

Nagarwala AK et al (2010)[20] also found significant improvement in hamstrings flexibility. Similar findings were seen by Spernoga et al (2001)[21], Bonnar et al (2004)[22],

Zakaria A et al (2012)[23] in normal subjects using the same protocol for PNF that was used in this study. During PNF-Hold Relax stretching autogenic inhibition of the target muscle takes place[24]

Autogenic inhibition refers to a reduction in excitability of a contracting or stretched muscle that in the past has been solely attributed to the increased inhibitory input arising from Golgi Tendon Organs (GTOs) within the same muscles. The reduced efferent (motor) drive to the muscle by way of autogenic inhibition is a factor believed to assist target muscle elongation.[25] A maximal contraction has been used because it was thought that GTOs only respond to high forces.[26] So autogenic induced reduction in target muscle activity along with target muscle lengthening and long lasting changes in ROM must be due to a more complex central and peripheral neurological organization which results in increase in a range of motion as the hamstrings are to be kept in the stretched position followed by isometric contraction of the same muscle. As the hamstrings are the joining source between the lower back region and posterior part of the thigh, reduced hamstrings tightness reduces the strain over the lower back region and reduces the low back pain.[27]

Statistically significant improvement in pain was found for VAS at rest (t=4.83, p<0.001) & VAS on activity(Z=-3.296, p=0.001) and in function for MODI (Z=-3.302, p<0.001). This is in accordance with Kotteeswaran K et al (2014) [28] who also observed that 4 weeks of PNF got significant improvement in pain scores (p<0.001). Hamstring muscles are more prone to tightness causing musculoskeletal problems.[29] It is thought that, due to the attachments of hamstrings to the ischial tuberosity, hamstrings tightness generates posterior pelvic tilt and decreases lumbar lordosis, which results in LBP.[30] As the PNF reduces hamstrings tightness there may have been reduction in the low back pain.

Limitations of the present study was long term follow up was not taken and Blinding was not done. The study did include the subjects having osteoarthritis of knee joint as the age advances person may more or less develop some amount of degenerative changes in the joint as well as muscles. BMI was not considered as a criterion during data analysis which

may have some effect. And there were different numbers of subjects in each age group.

5. Conclusion

Proprioceptive Neuromuscular Facilitation (PNF Modified hold-relax) improve hamstrings flexibility and reduce pain and disability over time.

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