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EFFECTIVENESS OF PNF STRETCHING VERSUS STATIC STRETCHING ON PAIN AND HAMSTRING FLEXIBILITY FOLLOWING MOIST HEAT IN INDIVIDUALS WITH KNEE OSTEOARTHRITIS

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ABSTRACT

Background: Osteoarthritis (OA) is a degenerative joint disease and one of the major public health problem that causes functional impairment and reduced quality of life. To compare the effectiveness of PNF Hold relax stretching versus Static stretching on pain and flexibility of hamstring following moist heat in individuals with knee osteoarthritis. Hamstring tightness is the major problem in knee osteoarthritis individuals. Therefore the need of study is comparing the effectiveness of PNF Hold relax stretching versus static stretching on pain and flexibility of hamstrings following moist heat in knee osteoarthritis participants. Determining the effects of PNF Hold relax stretching versus Static stretching along with moist heat on pain and hamstring flexibility by VAS and Active knee extension range of motion in knee osteoarthritis individuals.

Methods: 30 subjects with symptoms of knee osteoarthritis were randomly distributed into 2 groups 15 in each group. PNF Hold relax stretching along with moist heat is compared to Static stretching along with moist heat. Pain was measured by Visual Analogue Scale (VAS) and hamstring flexibility by Active knee Extension Range of Motion (AKE-ROM) by universal goniometer. Measurements are taken pre and post intervention.

Results: The results indicated PNF Hold relax stretching along with moist heat showed a statistically significant improvement in pain ($p < 0.05$) and improvement in hamstring flexibility ($p < 0.05$) when compared to Static stretching along with moist heat.

Conclusion: Subjects with PNF Hold relax stretching along with moist heat showed significant improvement in pain reduction and improving hamstring flexibility than Static stretching along with moist heat.

Keywords: Osteoarthritis, PNF stretching, Static stretching, Moist heat, VAS, AKE-ROM.

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INTRODUCTION

As given by WHO osteoarthritis (OA) is regarded a major public health problem with impaired functions that reduces quality of life [1]. In India the crude prevalence of clinically diagnosed OA was higher in the urban (5.5%) than the rural community [2]. Osteoarthritis is a degenerative joint disease which involves the cartilage and many of its surrounding tissues. There is osteophyte formation remodeling of subarticular bone, ligamentous laxity, synovial inflammation weakening of periarticular muscles [3]. These changes may occur as a result of an imbalance in the equilibrium between the break down and repair of joint tissue. The primary symptoms of OA seen are joint pain, stiffness and limitation of movement. According to Framingham study, among the individuals aged above 45 years the prevalence of radiographic knee OA was 19.2%, and in those above 80 years, it is 43.7% [3]. In rural India the incidence is 5.78% which is about 30% of all rheumatological problems. In India there is increased knee arthritis than western population [2]. There is secondary endemic OA in western Karnataka due to hereditary spondyloepiphyseal dysplasia (Handigodu disease) [2].

In individuals with knee OA, the joint has limited flexion and extension ROM (Range of motion). This is the result of pain, damaged articular cartilage, loss of extensibility of the capsule surrounding the joint and muscles acting over the joint [4]. Chondrocytes cells within the cartilage malfunction during the pathogenesis of OA and this may likely affect the flexibility of hamstring muscles [4]. Flexibility is defined as ability of a muscle to lengthen and allow joint to move through a ROM. The flexibility degree of hamstrings and quadriceps group of muscles contribute to smooth and precise ambulatory pattern in knee joint. Hence the individual is predisposed to injuries and musculoskeletal dysfunction with inadequate flexibility [5]. Hence there is a strong speculation of knee OA with poor hamstring flexibility [5].

Management of knee OA is mainly concentrated on reducing pain, increasing joint ROM and improving extensor muscle strength, neglecting ligamentous and muscular tightening which affects lower limbs function and gait [5]. The initial conservative management includes - Risk factor education of obesity, avoidance of ground level activities, Non steroidal anti inflammatory drugs, Symptoms slow acting drugs for OA (SYSADOA), Intraarticular injections of sodium hyaluronate [2]. The most surgical management done is total knee replacement in most advanced cases [2], physiotherapy management includes-Soft tissue manipulations, electrotherapy, and exercises [4].

The muscular tightness (or) protective muscle spasm develops in the knee musculature in 1st and 2nd grade of knee osteoarthritis that is the extensors of knee joint quadriceps are prone to weakness where as the flexors of the knee joint hamstrings are subjected to tightness. There is little concentration on stretching the musculature and greater concentration are imposed in strengthening the musculature. Hence there is a need to stretch the musculature around

the joint along with strengthening.

According to Ali Ghanbari, Nagarwal, Shanthi et al various stretching's like PNF and Static stretching are incorporated on hamstring tightness in normal individuals and moist heat prior to stretching was given in some, studies [6,7,8]. But the effectiveness of PNF stretching i.e., Hold-Relax technique and Static stretching along with moist heat on hamstring tightness and pain in knee osteoarthritis individuals has not been evaluated. Hence the need of study is to concentrate on reducing pain, improving hamstring flexibility by PNF stretching and Static stretching along with application of moist heat in individuals with knee osteoarthritis.

The research question concentrates on whether a structural stretching programme in early stages of OA benefits the OA individuals. Hence the aim of the study is comparing the effectiveness of Proprioceptive neuromuscular facilitation (PNF) stretching versus Static stretching on pain and hamstring flexibility following moist heat in individuals with knee osteoarthritis.

Determining the effects of PNF Hold relax and static stretching along with moist heat on pain and hamstring flexibility in knee osteoarthritis participants using VAS and Active knee extension range of motion (ROM) is the study objective.

METHODOLOGY

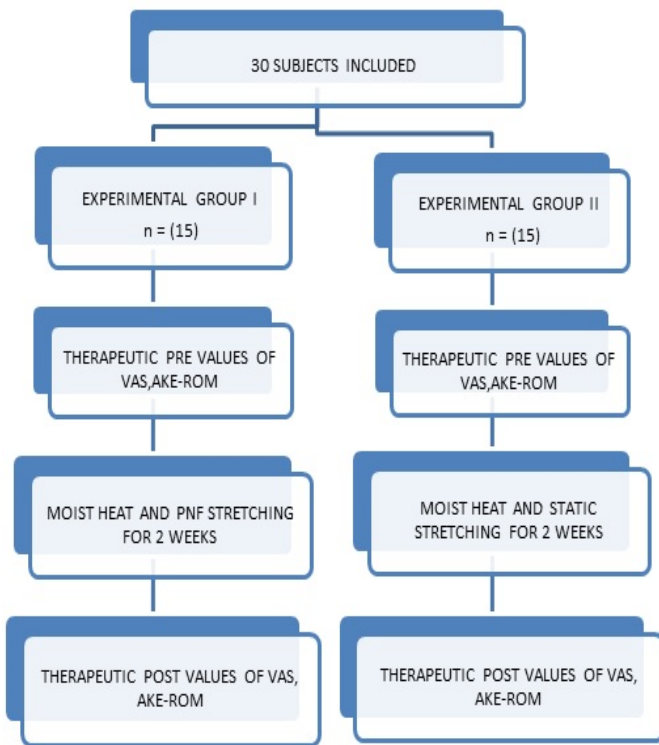
The materials used in the study are Wax therapy unit, Universal goniometer - 360°, Straps. The inclusion criteria is as follows age above 40 years, both genders, radiographic evidence of grade 1 and 2 in Kellegren and Lawrence criteria for knee OA [9], unilateral involvement, ascend and descend at least a flight of stairs, voluntary participants and the subjects excluded are as follows Low back ache, Sciatica, History of lower limb or spinal surgeries, Pathologies related to hip, knee and spine, Neurological disorders, Other musculoskeletal disorders associated with knee joint, IT band, adductor muscle and Sartorius muscle tightness, Non voluntary participants.

The study setting was in Department of Physiotherapy, SVIMS and BIRRD hospital, Tirupathi. The duration of study was 2 weeks and it is a Comparative study between two groups and the sampling is a Simple random sampling through which 30 subjects were taken and equally divided in to two experimental groups 15 in each group.

PROCEDURE

The subjects of study are selected randomly and assigned in to two experimental groups. The subjects were screened for inclusion and exclusion criteria after finding their susceptibility informed consent were taken. 30 subjects of males and females of age > 40 years are taken. Initially base line values of demographic details like Age, BMI, Sex, VAS and AKE - ROM was taken.

STUDY ALGORITHM



In experimental group I the subjects are laid down prone and wax pads were applied to the hamstring muscles for 20 minutes and laid down in supine with hip in 90° of flexion. The therapist should extend the subject's knee until a very mild stretching sensation is felt by subject in hamstring muscles. Then subject is asked to flex the knee against the resistance applied by hand of therapist. The subject is asked to use a force of around 50% of his maximal strength and an isometric form of contraction was gained in the hamstring muscles. The subject holds the contraction for 8 seconds and then the therapist command to relax the hamstring muscle. Immediately after the muscle relaxation the therapist further stretches the hamstring muscles up to a point where the subject reported a mild to moderate stretching sensation without any pain and held for 30 seconds. The procedure is repeated 3 times in every session. PNF stretching was applied for 2 weeks, 3 sessions a week with one-day rest in between 2 sessions. Treatment was continued for 2 successive weeks and hence every subject received 6 sessions of treatment.

In experimental group II subjects were given moist heat prior to stretching to the hamstrings. The subject was made supine with 90° of hip flexion. Then therapist passively extends the subjects knee until a mild to moderate stretching sensation was felt by patient without any pain and the position is held for 30 seconds and then the procedure is repeated 3 times with 10 seconds rest between stretches. The stretching is given alternatively 3 days a week for a period of 2 weeks.

STATISTICAL ANALYSIS AND RESULTS

Statistical analysis was done using the statistical software "EXCEL, SPSS 20.0" version. All 30 subjects received the 2 weeks of treatment in alternate sessions. Post outcome measures of VAS, AKE-ROM was taken and analyzed.

Table 1: Pre and post values of pain (vas) and AKE-ROM in PNF - hold relax stretching along with moist heat group

PNF	N	Mean	SD	Std. Error	df	t- value	p- value	
VAS	Pre	90	5.27	0.859	0.090	89	10.844	0.000
	Post	90	3.81	1.421	0.150			
AKE-ROM	Pre	90	35.21	10.453	1.102	89	12.640	0.000
	Post	90	43.83	11.805	1.244			

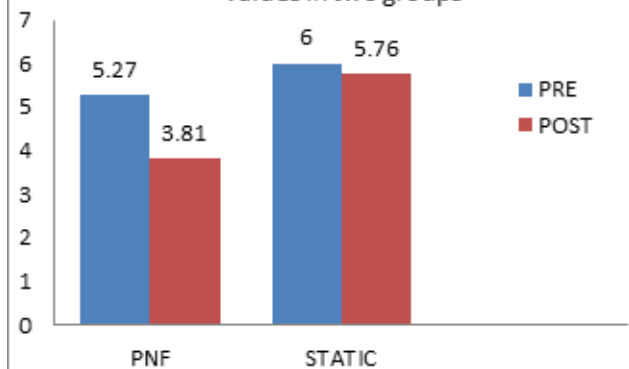
Pre and post mean values of pain (VAS) shows reduction of pain from 5.27 ± 0.8 to 3.81 ± 1.4 in PNF stretching group. Pre and post mean values of AKE-ROM shows significant improvement in ROM from 35.21 ± 10.4 to 43.83 ± 11.8 within the group.

Table 2: Pre and post values of pain (vas) and AKE-ROM in static stretching along with moist heat group

Static	N	Mean	SD	Std. Error	df	t- value	p- value	
VAS	Pre	90	6.00	0.636	0.067	89	5.366	0.000
	Post	90	5.76	0.708	0.075			
AKE-ROM	Pre	90	35.61	5.344	0.563	89	9.041	0.000
	Post	90	38.11	5.882	0.620			

Pre and post mean values of pain (VAS) of static group shows no significant reduction of pain from 6.00 ± 0.6 to 5.76 ± 0.7 and pre and post mean values of AKE ROM showed significant improvement in ROM from 35.61 ± 5.3 to 38.11 ± 5.8 within the group.

Graph 4: Comparison of VAS means of pre & post values in two groups



Graph 5: Comparison of AKE-ROM means of pre & post values in two groups

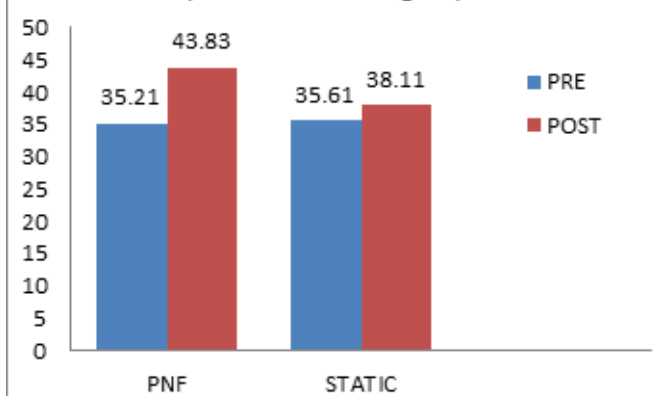
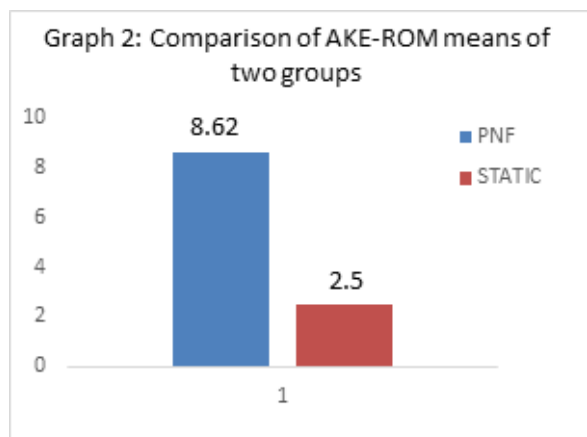
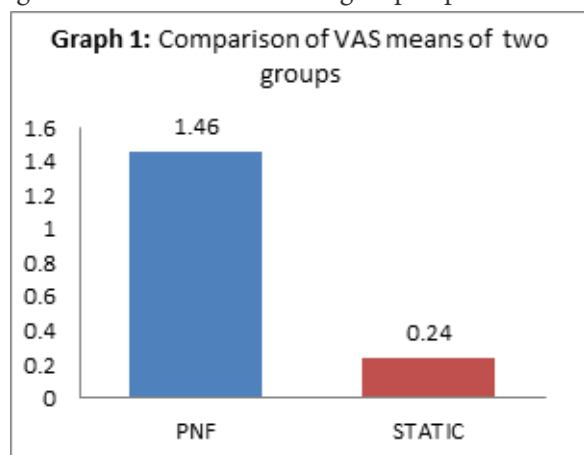


Table3: Comparison between pain (VAS) and AKE-ROM of PNF stretching and static stretching group using difference of pre and post values using two sample t-test:

Group	N	Mean	SD	Std. Error	Df	t-value	p-value
VAS	PNF	90	1.46	1.273	0.134	109.233	8.544
	Static	90	0.24	0.432	0.046		
AKE-ROM	PNF	90	8.62	2.835	0.299	178	3.138
	static	90	2.50	2.623	0.277		

Pre and post mean values of pain (VAS) shows 1.46 ± 1.2 in PNF group and 0.24 ± 0.4 in static group. As $p < 0.05$ there is significant difference between two groups basing on within difference.

Pre and post mean values of AKE-ROM shows mean value of 8.62 ± 2.8 in PNF group and 2.50 ± 2.6 in static group which shows a significant difference between two groups basing on within difference PNF group at $p < 0.00$



The results determined that PNF stretching with moist heat shows significant improvement in pain ($p < 0.05$) and improvement in AKE ROM ($p < 0.05$) when compared with static stretching along with moist heat group.

DISCUSSION

A present study result shows subjects in experimental group I has significant reduction in pain and improvement in AKE-ROM when compared to experimental group II. Pain relief in group I was obtained because of PNF-Hold Relax stretching as PNF stretching causes relaxation of muscles by changes in flow of blood. The technique of Hold – relax improves motor activity that affects vascular function. The muscle activation increases the release of vasoactive sub-

stances resulting in vascular dilatation [10,11]. Resultant vascular dilatation causes the pain producing substance P to wash out and helps in reduction of pain. This finding is accordance to results of Ali Ghanbari who demonstrated significant improvement in pain after implementing a structured stretching programme [11]. The moist heat application in the form of wax transmits heat energy to the tissues and this causes increase in local circulation to the area which in turn reduces pain [12]. Moist heat also has its direct effects on muscle extensibility [13]. This is in accordance with Dan Funk et al who indicated that there is a significant increase in hamstring flexibility by using moist heat packs in comparison with static stretching [14,15]. In static group even though there is application of moist heat the level of pain reduction is very minimal as there is deprived blood supply to the hamstrings after stretching.

Two groups were similar in their AKE-ROM before the stretching and after a structured stretching programme group I had better improvement than group II in AKE-ROM. Group I showed significant increase in AKE-ROM improved hamstring flexibility and decrease in pain with hold relax PNF stretching and moist heat. The primary limiting factor of joint movement are muscle, fascia, capsule and tendon. So there is a need to concentrate on the muscle spindle and golgi tendon organ in the ability of muscles to lengthen in response to stretch, as well as the passive structures. The PNF Hold relax stretch address the passive components [16]. HOLD relax stretching has its effects on musculotendinous units function. The musculotendinous units gets lengthens or deforms as it is being stretched. But a single session of Hold relax stretching is not enough to deform tissues to produce a permanent change [17]. In our study there was an immediate increase in AKE-ROM after the Hold relax stretching every day as it facilitates the golgi tendon organs which in turn facilitates reflexive relaxation of the muscles. This is in accordance with Knott [18]. The effectiveness of stretching was not maintained until the next session but at end of the week on 5th or 6th session of stretching there is a maintenance of extensibility of the hamstring muscles as evident by AKE-ROM.

Group II subjects received static stretching. A randomized controlled trial by Mandeep kaur showed static stretching causes plastic stretching which results in irreversible tissue elongation [19,20]. The stretching activity causes a neural inhibition of muscle group. Due to neural inhibition there is reduced reflex activity which in turn causes greater relaxation and decreased resistance to stretch [14]. A study by Reid DA on extensibility of hamstring muscles showed due to increase in the blood supply the AKE-ROM can be increased with static stretching in knee osteoarthritis individuals [21]. In our study the AKE-ROM of the static stretch group showed a very minimal improvement in extensibility of the hamstring muscles. This is because the muscle extension due to static stretching decreases muscle blood flow because of two physical changes that is longitudinal extension of blood vessels with in muscle extension and the increase of intramuscular pressure during stretch-

ing which is in accordance with Alighanbari [22]. Due to lack of maintenance of extensibility of the musculature the AKE-ROM improvement is very minimal in static stretching group compared to PNF-Hold relax group which has an effective maintenance of extensibility of the musculature [23,24]. Along with this the pain reduction is also highest in PNF group than static group. This is due to decreased blood supply to hamstring muscles due to longitudinal extension of blood vessel within the muscle.

CONCLUSION

Subjects who underwent PNF Hold relax stretching along with moist heat showed significant improvement in hamstring flexibility and reduction of pain at the end of 2 weeks when compared to subjects with static stretching along with moist heat. Therefore, application of PNF Hold relax along with moist heat can be considered beneficial in improvement of hamstring flexibility and reduction of pain in acute stage knee osteoarthritis individuals.

LIMITATIONS AND RECOMMENDATIONS:

LIMITATIONS

- Follow up of subjects after the study is not possible.
- Duration of study was short.
- Small sample size.

RECOMMENDATION

- Study can be conducted with large sample size.
- long duration studies are recommended with long follow up period to access long term benefits
- Along with stretchings to maintain the flexibility of hamstrings the subjects can be advised home stretching programme.

REFERENCES

- [1] Hafez AR et al. Treatment of Knee osteoarthritis in relation to Quadriceps And Hamstring Length. *J. Phys. Ther. Sci.* 2013;25(11):1401-1405.
- [2] G. S. Kulkarni. Text book of orthopaedics and trauma. 2nd edition (vol 4);2008.
- [3] Anna Litwic et al. Epidemiology and burden of osteoarthritis. *Br Med Bull.* 2013;105:185-199.
- [4] Reid DA, McNair. Effects of an acute hamstring stretch in people with and without osteoarthritis of knee. *Physiotherapy* .2010; 96(1):14-21.
- [5] Onigbinde AT et al. An assessment of hamstring flexibility of subjects with knee osteoarthritis and their age matched control. *Clinical Medicine Research.* 2013;2(6):121-125.
- [6] C. Shanthi et al. A study to compare effectiveness of static stretching and hold relax technique over hamstring flexibility. *Int J Physiotherapy.* 2014; 1(4): 205-208.
- [7] Carsandra Bernhart. A review of stretching technique and their effects on exercise. liberty university. 2013.
- [8] Nagarwal AK, Zutshi K, Ram C.S, et al. Improvement of hamstring flexibility: A comparison between two PNF stretching techniques. *International journal of sports science and engineering.* 2010; 4(1):025-033.
- [9] J.H.Kellgren, J.S.Lawrence. Kellgren – Lawrence grading scale to assess severity of knee osteoarthritis.
- [10] Carter A, Kinzey S, Chitwood L et al. Proprioceptive neuromuscular facilitation decreases muscle activity during the stretch reflex in selected posterior thigh muscles. *Journal of sports rehabilitation.* 2000;9(4):269-278.
- [11] Gribble PA, Guskiewicz KM et al. Effects of static and hold relax stretching on hamstring ROM using the flex ability LE 1000. *J Sports Rehabilitation* 1999;8(3):195-208.
- [12] John Low, Ann reed. Therapeutic conduction heating. *Electrotherapy explained principles and practice.* 3rd edition; 2000.
- [13] Sawyer Patrick C. Effects of Moist Heat on Hamstring Flexibility and Muscle Temperature. *J Strength Cond Res.* 2003;17(2):285-290.
- [14] Rose S, Draper D, Schulthies S, et al. The stretching window part two: rate of thermal decay in deep muscle following 1-MHz ultrasound. *J Athl Train.* 1996; 31:139-143.
- [15] Dan funk et al. Efficacy of moist heat pack application over static stretching on hamstring flexibility. *Journal of strength and conditioning research.* 2001;15(1):123-126.
- [16] Nicole Lee Lounsberry. Therapeutic Heat: Effects of Superficial and Deep Heating Modalities on Hamstring Flexibility. *The Osprey Journal of Ideas and Inquiry* (2008). All Volumes (2001-2008):Paper 138.
- [17] Taylor DC, Dalton JD, Seaber AV et al. Viscoelastic properties of muscle-tendon units. The biomechanical effects of stretching. *A M J Sports Med.* 1990;18(3):300-309.
- [18] Dena Gardiner. The stretch stimulus and stretch reflex. *Principles of Exercise Therapy.* 4th edition; pg:82-83.
- [19] Mandeep kaur, Rajesh Paul, Sandeep kaur. A randomized controlled trial to study effectiveness of static stretching versus PNF stretching on flexibility of hamstring muscles following superficial heat in athletes. *International journal of scientific and research.* 2014;4(7):1-4.
- [20] Tarpan shah, Neha vekariya, Hiral Gandhi. An assessment of comparative effect of four different types of hamstring stretching techniques on hamstring tightness. *Indian journal of physiotherapy and occupational therapy.* 2015;9(1):204-209.
- [21] Reid DA, MC Nair PJ. Passive force, angle and stiffness changes after stretching of hamstring muscles. *Med Sci Sports Exercise.* 2004;36 (11):1944-1948.
- [22] Ali Ghanbari et al. Comparing hold relax-proprioceptive neuromuscular facilitation and static stretching techniques in management of hamstring tightness. *Indian journal of physiotherapy and occupational therapy.* 2013;7(1):No.:126-130.
- [23] Scott G. Spornoga et al. Duration of maintained ham-

string flexibility after a one-time, modified hold relax stretching protocol. *Journal of athletic training*. 2001;36(1):44-48.

- [24] Feland JB, Myrer J, Merrill R. Acute changes in hamstring flexibility:PNF versus static stretch in senior athletes. *Physical therapy in sports*.2001;2(4):186-193.

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