



ISSN: 2456-4419

Impact Factor: (RJIF): 5.18

Yoga 2019; 4(1): 164-167

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www.theyogicjournal.com

Received: 12-11-2018

Accepted: 16-12-2018

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Different stretching techniques for improving flexibility in males with hamstring tightness: A review

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Abstract

Reduced flexibility of muscles leads to tightness in the muscles which further limits range of motion (ROM). The aim of the study is to find out the effects of PNF and NM techniques in improving hamstring and back flexibility in males with hamstring tightness. The literature search of experimental studies published between year 2005 to 2018 on efficacy of proprioceptive neuromuscular facilitation and neural mobilization was conducted through electronic databases (Google scholar, Pubmed, PEDro, Elsevier, Cochrane library) and studies were included according to inclusion criteria. The study concludes that there is need to explore more about the different types of PNF and NM techniques to evaluate its effects on straight leg raise, knee extension angle and sit and reach test on healthy male subjects with hamstring tightness.

Keywords: Sit and reach test, knee extension angle, straight leg raise

Introduction

Flexibility is the ability of a muscle to lengthen and to allow one joint (or more than one joint in series) to move through a range of motion (ROM) without limitations or pain (Song *et al.* 2015) [19]. Reduced flexibility of muscles leads to tightness in the muscles which further it limits range of motion (ROM). Flexibility decreases with the advancing age (Varangaonkar *et al.*, 2015) [20]. The tightness in hamstring is one of the major contributing factors which are associated with musculoskeletal injuries in adolescents and adults (Nishikawa *et al.* 2015) [14]. In relation to gender differences, hamstring tightness is found more in males (75%) as compared to females (35%) (Bakhtiari *et al.* 2014) [8].

Due to sedentary life style, most of the individuals have lack physical activity which becomes a major cause of reduced hamstring flexibility (Singh S *et al.* 2015) [18]. There are several factors which may affect the hamstring flexibility like age, gender, tissue temperature, strength, stiffness, awkward posture, body mass index (BMI), occupation, physical inactivity and reduced warm up (Fasen *et al.* 2009, Singh *et al.* 2015) [6, 18]. Reduced hamstring flexibility can cause biomechanical changes which can result into patellofemoral dysfunction, pubic pain, patellar tendonitis, hamstring strains, plantar fasciitis, gait limitation, risk of falling, thoracic khyphosis, spondylolysis, disc herniation and postural disorders (Morcelli *et al.* 2013; Perin *et al.* 2015) [11, 15]. The hamstring muscle and back muscles are part of posterior anatomical chain in body, thus improvement in hamstring flexibility might also increases back flexibility (Grieve *et al.* 2014) [7].

There are several methods to improve flexibility which are given to attain a visible change in hamstring tightness. Both electrotherapy and manual therapy is used to improve the flexibility. The techniques commonly used are like cryotherapy, soft tissue massage, myofascial therapy, short wave diathermy, ultrasound, kinesio-taping and eccentric training. The stretching techniques are widely used by most of the clinicians; some of them are such as active stretching, passive stretching, ballistic stretching, muscle energy technique (MET), proprioceptive neuromuscular facilitation (PNF), neural mobilization (NM). Both PNF and NM are effective as adjunct to other treatment which helps in improving range of motion and thus, flexibility.

PNF was developed by Knot and Voss in 1968, is more advanced form of flexibility that involves both stretching and contraction of muscle group being targeted.

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There are various techniques of PNF such as - rhythmic initiation, combination of isotonics, reversal of antagonist, repeated stretch replication, contract relax, hold relax, contract relax- antagonist contract, hold relax- antagonist contract.

Neural mobilization (NM) was firstly described by Elvey in 1986. This technique involves the stretching and relaxing of nerves in order to maintain normal muscle tone and ROM (Butler, 2000) [4]. NM can be given by two different methods – (i) Neural tensinors (ii) Neural Sliders. It focuses mainly on restoring neural structures plasticity simultaneously initiating and increasing the relative mobility of peripheral neural tissue. It is basically a manual method of applied force (actively or passively) to neural structure through posture and multijoint movements (Park *et al.* 2014) [16]. Till date there is no literature review to update about the effects of PNF and NM in treating hamstring tightness. Therefore, this review study is aims to find out the effects of PNF and NM techniques in improving hamstring and back flexibility in males with hamstring tightness.

Methods

The literature search of experimental studies published between year 2005 to 2018 on efficacy of proprioceptive neuromuscular facilitation and neural mobilization was conducted through electronic databases (Google scholar, Pubmed, PEDro, Elsevier, Cochrane library).

Inclusion criteria were i) full texted studies ii) randomized, controlled and experimental studies are included iii) studies including the subjects with age range between 10-30 years iv) studies including only male subjects v) studies with normal healthy subjects vi) studies including subjects with single/ bilateral hamstring tightness. Excluded studies i) reviews, systematic review and cross over design ii) studies on animal subjects iii) studies including hamstring tightness in other conditions (patellofemoral dysfunction, pubic pain, patellar tendonitis, hamstring strains, plantar fasciitis, gait limitation, risk of falling, thoracic khyphosis, spondylolysis, disc herniation and postural disorders) iv) studies including PNF and NM as adjunct treatment techniques.

Table 1: Initially 27 articles were searched of which nine articles fulfills the inclusion criteria. Conclusions of evidences are summarized in Table 1.

Authors (years)	Study design (sample size)	Aims and objectives	Treatment Groups	Outcome measure	Results and findings	Conclusion
Nagarwal et al (2010)	Randomised pre-test post-test control group design (n= 45)	To determine the effectiveness of two PNF stretching techniques for improving hamstring flexibility and to compare the effectiveness of two PNF stretching techniques (Hold Relax and Contract Relax- Antagonist Contract) for improving hamstring flexibility.	Group I PNF – hold relax stretching (n=15) Group II PNF- contact relax antagonist contract (n=15) Group III Control group- no treatment was given (n=15)	Active knee extension ROM	The results demonstrated significant improvement in hamstring flexibility for subjects of group B when compared with those of group A (P = 0.03) at the end of three weeks, with improvement ranging from 0.50 to 15.66 degrees of active knee extension ROM at 95 % confidence interval.	Both the techniques viz. PNF Hold Relax and PNF-CRAC are almost equal in their clinical effectiveness for improving hamstring flexibility and that either of the techniques may be used in clinical practice for improving hamstring flexibility.
Zakaria et al (2012)	Pre-post control group design (n=30)	To find out the efficacy of different PNF stretching techniques in improving Hamstring muscle Flexibility	Group I - Control group self stretch (n=15) Group II PNF stretch (n=15)	Straight leg raise test	Results revealed that Pre test and Post test values of the Control group and Experimental group were statistically analyzed by means of t-test. The Post test values of Experimental and Control group were analyzed by Chi square test (2 test). The Significance level used for this study is P<0.05.	Study concluded that though statistically there is no significant difference between self stretch and therapist applied PNF stretch, both are effective treatment methods but Therapist applied PNF Stretch is clinically more significant over self stretch.
Lim et al (2014)	Randomized controlled trial (n=48)	The purpose of this study was to investigate the effects of two different stretching techniques on range of motion (ROM), muscle activation, and balance.	Group I- Static stretching group (n=16), Group II- PNF stretching group (n=16), Group III Control group (n=16).	Active knee extension angle, Muscle activation during maximum voluntary isometric contraction (MVC) Static Balance	Both the static stretching and the PNF stretching groups showed significant increases in knee extension angle compared to the control group. However, there were no significant differences in muscle activation or balance between the groups.	Static stretching and PNF stretching techniques improved ROM without decrease in muscle activation, but neither of them exerted statistically significant effects on balance.
Khalili et al (2014)	Randomized Control trial	The aims the study was to compare the	Group I- US with stretching	Straight leg raise	The results of the study indicated that ROM in	The two treatment methods had similar

	(n=34)	effects of ultrasound (US) together with stretch and hold relax (HR) techniques in increasing the muscle length	(n=12) Group II- HR (n=12) Group III- Control group did not received any treatment (n=10)	Passive knee extension	the two treatment groups increased significantly compared to control group. Comparison of the two treatment methods, US with stretch and HR, revealed that there was no significant difference	effects and there was no significant between them, while significant improvement was seen in the experimental groups compared with the control group.
Hasani et al (2014)	Randomized control trial (n=60)	This study aimed to introduce more effective method, either a static stretch or hold relax	Group I- Hold relax (n=20) Group II- static stretch (n=20) Group III- Control group (no treatment) (n=20)	Knee extension ROM	Results of the study showed that both methods have significant effect on knee ROM ($p < 0.001$). But no significant difference was observed between the static stretch and hold-relax ($p=0.246$)	The study concluded that both techniques (static stretch and hold relax) have a significant effect on flexibility and increasing the knee ROM. But neither is superior regarding their effect.
Ahmed et al (2015)	Randomized control trial (n=45)	The aim of present study was to compare the effectiveness of modified hold-relax stretching and static stretching in improving the hamstring muscle flexibility.	Group I- modified hold-relax stretching (n=15) Group II- static stretching (n=15) Group III- control groups (n=15)	Passive knee extension ROM	Results indicates that post hoc analysis revealed an insignificant difference between the modified hold relax stretching and static stretching groups. There was a significant difference between the static stretching and control groups and between the modified hold-relax stretching and control groups.	The results of this study indicate that both the modified hold-relax stretching technique and static stretching are equally effective, as there was no significant difference in improving the hamstring muscle flexibility between the two groups.
Nimmala et al (2014)	Randomized controlled trial (n=60)	The objective of present study is to compare the effectiveness of static stretch and HR techniques over hamstring flexibility	Group I- Static stretch (n=30) Group II- Hold relax (n=30)	Knee extension ROM	The results shows that both static stretch and HR are effective treatment techniques for improving knee extension ROM with HR being highly significant highly significant.	This study concludes that the HR Technique method has proved to be better technique then the static stretch for improving hamstring flexibility.
Rani et al (2015)	Pre test –post test experimental design (n=60)	To compare the effects of two active stretching techniques- modified hold relax technique of PNF and neural mobilization as described by Butler, for improving the flexibility of hamstrings	Group I –PNF- Hold relax Group II- Neural mobilization	Active knee extension	Results showed a significant increase in hamstrings flexibility achieved with both the techniques ($p = 0.000$ for both neural mobilization and hold-relax). Both techniques were found to be significant but the comparison revealed no statistically significant difference between these two techniques. ($p\text{-value} = 0.953$).	Both HR and neural mobilization are equally effective in improving hamstrings flexibility in normal adults.
Ahmed et al (2016)	Randomized clinical trial (n=40)	The aim of the study was to compare the effectiveness of neurodynamic and static stretching techniques on hamstring flexibility in healthy male subjects.	Group I- Neurodynamic sliding stretching technique (n=20) Group II- Static stretching (n=20)	Active knee extension test Straight leg raise test	There was a significant improvement in hamstring flexibility following application of both neurodynamic and static stretching but the improvement in the neurodynamic group ($p < 0.001$) was better than that of the static group ($p < 0.02$).	Results suggest that a neurodynamic stretching could increase hamstring flexibility to a greater extent than static stretching in healthy male subjects with a tight hamstring.

Discussion

The present study was conducted to scrutinize the literature to determine the effects of different stretching techniques for improving flexibility in males with hamstring tightness. PNF is a positive, integrated approach. The underlying philosophy of this concept of treatment was given by Kabat in 1950, which states that all human beings, including those with disabilities have untapped existing potential. Different techniques use concentric, eccentric and static muscle contractions which along with properly graded resistance and suitable facilitatory techniques are combined and adjusted according to the needs of the patients. The main goal of PNF techniques is to improve functional movement through facilitation, inhibition, strengthening and relaxation of muscle groups (Adler *et al.* 2008)^[1].

Further, NM is basically a manual method of applied force (actively or passively) to neural structure through posture and multijoint movements (Park *et al.* 2014)^[16]. NM helps to increase blood flow & axoplasmic flow, to reduce neural edema & nociceptive impulses and also in breakdown of adhesions between neural tissue and its surrounding connective tissue (Salian & Chaurasia, 2016). The study indicates that very little work is done on evaluating the effects of PNF and NM on sit and reach test. Also, only few studies have investigated by researchers to find the effects of different types of PNF techniques on flexibility. Further, the study reveals the lack of evidence regarding the effectiveness of neural mobilization on flexibility.

Conclusion

The study concludes that there is need to explore more about the different types of PNF and NM techniques to evaluate its effects on straight leg raise, knee extension angle and sit and reach test on healthy male subjects with hamstring tightness.

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