



SIGNIFICANCE OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ON PHYSICAL FITNESS PHYSIOLOGICAL FUNCTION AND REHABILITATION: A NARRATIVE REVIEW

Physical Education

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ABSTRACT

Background: Proprioceptive neuromuscular facilitation is an important maneuver initially used as rehabilitation technique from the mid 1900's. Recently it also used as a physical fitness and sports performance improvement technique. However, a comprehensive review in these areas is not available. **Aim of the study:** Therefore, the aim of the present study was to prepare a narrative review to understand the significance of PNF technique on physical fitness, physiological function and rehabilitation process. **Methods:** Total 54 experimental research articles were finally selected after thoroughly examined the inclusion and exclusion criteria from the online data sources and presented systematically. **Discussion:** Interpretation were made on the following three areas: PNF and physical fitness; PNF and physiological functions; PNF and rehabilitation process. In the area of physiology, further cardiovascular, respiratory and neurological functions were also separately reported. **Conclusions:** It may be concluded that PNF technique improves flexibility, strength, coordination. It is reported that PNF technique develops circulo-respiratory function and neurological efficiency. PNF technique may be effectively applied for the rehabilitation of musculoskeletal, circulo-respiratory and different types of neurological illnesses and injuries.

KEYWORDS

PNF; Physical fitness; Physiological function; Rehabilitation

1. INTRODUCTION

Proprioceptive neuromuscular facilitation (PNF) was first introduced in the early 1900's by Charles Sherrington. The thought of PNF was started clinically in the late 1940's by Dr. Herman Kabat. PNF combined with three terms 'P' for proprioceptive which means proprioceptors in the body i.e., muscle spindle or stretch receptors, golgi tendon organs and pacinian corpuscles. Proprioceptive is responsible to do with any of the sensory receptors that gives information concerning movement and position of the body posture and its feedback. 'N' indicates the neuromuscular junction that is involving nerves and the muscle. 'F' denotes facilitation which make the thing easier. The benefits of PNF techniques are performance development in sports, prevention of injury, rehabilitate from illness and other injuries. These benefits are possible through the increase of range of motion (ROM), development of joint and muscle flexibility, strength and improvement of functional activities.

Neurophysiological mechanisms of PNF are facilitation and inhibition, resistance, irradiation and reflexes. However, facilitation increase the excitability of motor neurons and inhibition decrease the excitability for the combination of two process increase flexibility and muscular resistance (Harris, 1978; Knott and Voss, 1968; Prentice, 1983). Irradiation is the byproduct of maximal resistance, its spreading excitation to central nervous system which make synergistic of muscle contraction (Adler et al. 2000; Surburg, 1981). Muscle length can be changed due to the tension of the muscle which is detected by stretch reflexes (Alter, 2004).

PNF technique is very popular method over the world from the inception because of its strong scientific background. However, there are very less supportive documents which allow PNF for physical fitness development and physiological function improvement. PNF is already established as an effective rehabilitation procedure. But the area of specialty in rehabilitation has not yet been properly identified and decided. This review work was a part of research project on 'PNF and brain function', identification to understand the under laying mechanism of PNF technique.

2. Aim of the Study

The aim of this study was to prepare a narrative review on the working technique and biological significance of proprioceptive neuromuscular facilitation on physical fitness, physiological function and rehabilitation process.

3. METHODS

3.1 Acquisition of Evidence

Online searching procedure was adopted for acquisition of evidences. The electronic databases were carefully searched to meet the purpose of reviewing the literatures and its narration. We used the following databases to identify studies from 1980 to May 2020. The role of PNF on physical fitness, physiological function and rehabilitation aspects was identified from: PubMed; Elsevier; Archives of Budo; Web of Science; IPNFA; Biomed Central; Springer; Somatosensory and Motor research; Science Direct; PEDro; and Cochrane library. The relevant published articles were detected by using the following keywords like: PNF and rehabilitation; PNF and sports training; PNF and circulatory system; PNF and respiratory system; PNF and muscular system; PNF and nervous system. Only the experimental studies were extracted from various searches.

3.2 Inclusion and Exclusion Criteria

INCLUSION CRITERIA

- Only experimental studies on PNF technique were considered.
- Following three broad areas were included in this review study for literature survey: PNF and physical fitness parameters, iii) PNF and physiological variables, iv) PNF for rehabilitation process.

EXCLUSION CRITERIA

- Review, survey, case and historical studies were excluded from this narrative review presentation.

3.3 Selection Procedure of Review Articles

The total records of 95 articles identified from search database at the initial stage. After removed of duplicates, 84 titles and abstracts were read out thoroughly. After examined all the full texts, 30 studies were excluded and finally 54 experimental full texts articles were included to made narrative review. For the final qualitative synthesis these 54 studies fulfill the every criteria of this planned narrative review. Detail article selection procedure followed for this study is presented in the Figure No.1.

4. DISCUSSION

After thoroughly studied all the experimental articles we categorized the uses of PNF in different aspects of physical fitness, physiological function and rehabilitation process. All that are summerized in the following paragraphs for better understanding of the functional mechanism of PNF technique and its effectiveness on the human body.

A.PNF and Physical Fitness

PNF stretch technique and that life time training might counter act age

related declines in joint ROM (Ferber,2002). PNF Hold Relax and PNF Contract Relax- Antagonist Contract are almost equal in their clinical effectiveness for improving hamstring flexibility (Nagarwal,2010).Upper extremity PNF pattern did significantly affect the mean upper trapezius, middle trapezius and lower trapezius activity (Witt,2011). Resistance training with PNF stretching group had slightly more improvement in strength, muscle volume and flexibility when compared to the resistance training group (Arazi,2012). An individuals can implement PNF stretching techniques with a partner or alone with a strap to improve ROM (Maddigan,2012).PNF training can increase the flexibility, strength and endurance of hamstring muscle in non-athlete men (Sanavi,2013). Muscle energy technique, PNF stretching and static stretching produce a significant improvement in hamstring flexibility (Kumar,2015). PNF stretching may change the length –tension association (Cengiz,2015).PNF stretching, it is not necessary to apply the maximum intensity of muscle contraction (Kwak,2015).Contract-relax PNF stretching might be effective to improve dynamic balance control (Ghram,2016). Static stretching and PNF stretching significantly effective in improving hamstring

muscle range of motion when compared from pre test with post test (Karthikeyan,2016). A single session of soft tissue mobilization with proprioceptive neuromuscular facilitation immediate improvement in glenohumeral external rotation and overhead reach (Gadpal,2017). PNF stretching group, the pennation angle in the stretched position and plantar flexor maximum voluntary contraction decreased significantly (Konrad,2017). PNF stretching of the hamstrings may not adversely affect the H:Q ratios, and consequently not negatively affect injury risk associated with muscular strength imbalances (Ruas,2018). PNF contract relax antagonist stretching technique was better than PNF hold-relax stretching technique in improving the hamstring muscle flexibility (Ramachandran,2018). A single dose of contract relaxes PNF stretching of hip abductors and adductors muscle improves mideolateral dynamic balance (Szafraniec,2018). Repetitive high-intensity stretching may cause heavy burden on muscle tissues, and pain caused by high-intensity stretching can hinder muscle performance. Moderate stretching intensity is recommended and considered conducive to maintaining the effects of stretching while ensuring its safety (Lim,2018).

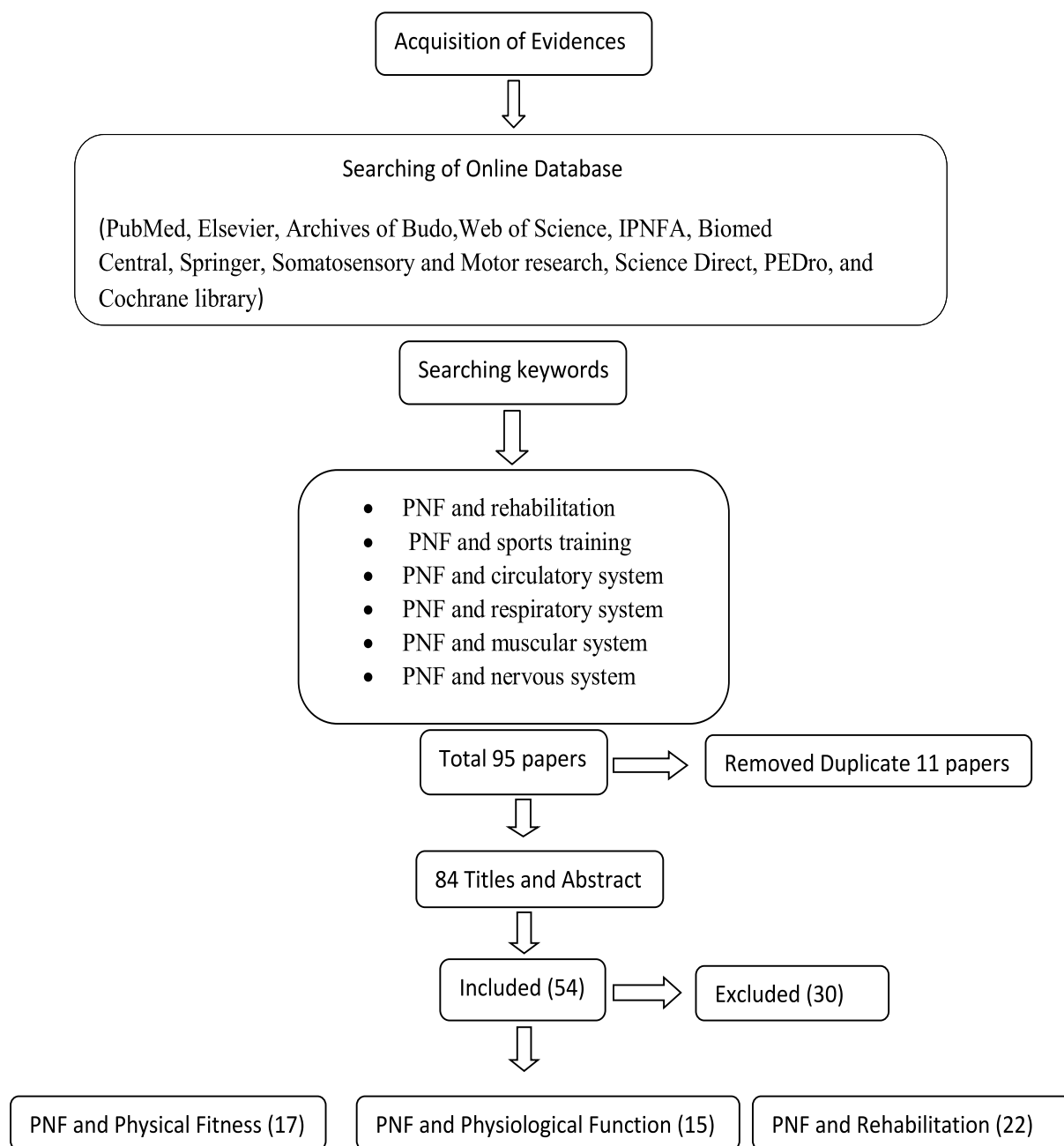


Figure No: 01 Schematic Presentation Of The Detail Article Selection Procedure

B. PNF and Physiological Function

1. PNF and Cardio-Vascular Function

PNF exercise increased hemodynamic responses and blood lactate concentration that indicate a high strain on the cardiovascular system and anaerobic metabolism in healthy subjects (Gultekin,2006). PNF increased the tension of vascular friction, which relates to better vascular function (Hurtado,2011).PNF stretching of hamstring with valsava maneuver shows significant increase in heart rate and blood pressure compared to PNF stretching of pectorals (Krima, 2016). Combination of MLD and PNF induces potent synergistic effects on edema volume, shoulder range of motion (ROM), pain, and depression in patients with lymphedema (Ha,2017).

2. PNF and Respiratory Function

A single application of respiratory stimulation through PNF positively affect air flow in the respiratory tract (Ptaszowska,2019). PNF alone with chest physiotherapy are better and effective in improving saturation of oxygen, pulmonary compliance and reduction of heart rate, respiratory rate (Ashtankar, 2019).The association of PNF with CRT may be a viable and accessible alternative to increased cardiorespiratory function in patients with stroke (Souza,2020).

3. PNF and Neurological Function

PNF can enhancing the movement efficiency of the joint, reduction in EMG-reaction time and motor evoked potentials (MEP) amplitude increased and MEP latency decreased in the facilitation position as a function of the proximity of the muscle to the joint (Shimura,2002). The motor imagery coupled with PNF to enhance and retain ROM yields superior results to physical training used alone and can benefit both athletes and those undergoing rehabilitation (Williams,2004). After 10 weeks balance and knee extension torques were improved in training group while no differences were found for control group. These improvements were mainly attributed to central nervous system adaptation, since no differences were found for neuromuscular activation level and co activation (Pereira, 2012).The PNF can be considered favorable also in relation to the cortical behavior, reinforcing its use in rehabilitation processes (Costa,2017). An increase in alpha absolute power in the left dorsolateral prefrontal cortex and upper left parietal cortex of the PNF group, suggesting these areas work together to execute a motor action. The PNF group showed a greater alpha absolute power compared with the other groups, indicating a specific cortical demand for planning and attention, reinforcing its use for the rehabilitation of individuals (Lial,2017).PNF seems to be capable of promoting cortical adaptations that lead to the recruitment of both hemispheres, thus influencing cortical organization in more complex tasks (Moreira,2017). The training contract-relax of proprioceptive neuromuscular facilitation may cause some augmentation in supraspinal and postsynaptic inhibition on the motoneuron pool (Kaya, 2018).PNF diagonal movement patterns have been described as: having beneficial effects in cortical adaptations and cortical organization resulting in motor learning effects (Smedes,2019).

C. PNF and Rehabilitation

Static and dynamic PNF programs may be appropriate for improving short-term trunk muscle endurance and trunk mobility in people with chronic low back pain (CLBP) (Kofotolis,2006). PNF technique has significantly effect on gait parameters & functional mobility as compared to conventional therapy in patients with hemiplegia (Kumar,2012). The distal irradiation in lower limbs became evident, reinforcing the therapeutic actions to the PNF indirect muscular activation (Gontijo,2012). Exercise programs with PNF techniques can improving the function of myofascial pain syndrome patients (Lee,2013). PNF combination pattern training for six weeks was more effective for patients with low back pain than performing ball exercise (Lee,2014). PNF without other therapy may be a more practical and less expensive choice for clinical care (Magalhaes,2015).PNF and static stretching for four weeks significant differences in the gait parameter between two groups (Ali,2015). PNF technique was effective in relieving pain, resting ROM and restoring function among subjects with adhesive capsulitis. (Ravichandran,2015). PNF training after 6 weeks improved the balance ability of elderly patients with chronic low back pain (Young,2015). PNF and deep breathing exercise can increase the range of motion of the patients (Lee,2015).PNF may be an effective and specific component of rehabilitation in the recovery of function in the early phase post injury for a patient with a major upper arm traction avulsion amputation reconstructed by a pedicled latissimus dorsi muscle (Chen, 2016).

Improvement in activities of daily living of sub-acute stroke survivors with and without cognitive impairments after 12 months PNF and task specific balance training protocol. (Prosper,2017). Abdominal muscle strengthening training by using PNF was effective in enhancing pulmonary function and decreasing pain and functional disability index in patients with CLBP (Kim,2017). 6 weeks of PNF training significant longer stance phase duration of the affected side than the control group (Sung,2017). Simultaneous application of PNF and taping for 30 minutes has carryover effects that can improve stroke patients' gait ability, even after the removal of the tape (Park, 2017). PNF exercises are very much effective in improving muscle tone, functional outcome and quality of life (Chaturvedi,2017). Kinesiotherapeutic technique may be effectively used in the prevention, treatment and rehabilitation of shoulder disorders (Comel,2018). PNF technique might have a positive effect on increasing the functional abilities of subjects with incomplete spinal cord injury and further research is required with a large number of subjects. (Crnkovic,2018). Combined training using PNF techniques and treadmills may be useful in improving the balance and walking ability of stroke patients. (Kim, 2018). 4 weeks intervention both core stabilization exercise and PNF training group demonstrated significant improvement in deep trunk muscle activity compared to the control group. (Areudomwong,2019). Three weeks PNF training provided better pain intensity, disability and static balance ability then general trunk exercises for working age individuals with chronic low back pain. (Areudomwong,2019a). PNF group is superior in decreasing pain and reducing disability, increasing ROM and improving function. (Tedla,2019).

5. CONCLUSION

After thoroughly reviewing all the selected 54 articles the following conclusion was drawn for further practical implication and development in this area.

- i) PNF and Physical Fitness: PNF technique may improve general flexibility, specific range of motion, local muscular strength, coordination and functional activities of daily living.
- ii) PNF and Physiological Function: PNF maneuver may develop physiological function such as muscle contraction and relaxation ability, respiratory function, cardio-vascular efficiency and effective neurological function in somatic, autonomic and central nervous system.
- iii) PNF and Rehabilitation: PNF may be effectively applied for the rehabilitation of musculoskeletal problem, cardio-vascular and respiratory illness and injuries, especially different types of neurological dysfunction, impairment and injuries.

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