

An Introduction to Proprioceptive Neuromuscular Facilitation Treatment!

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Abstract

Proprioceptive Neuromuscular Facilitation (PNF) is a valuable technique used for the treatment of patients who have lost voluntary control of their bodies and need rehabilitation to regain control of their movements. Although now this treatment procedure is known and used worldwide, when it was first developed over 70 years ago, it was a totally new and startling concept. It consists of an intricate and complicated program, and detailed instruction is required to truly develop an effective therapeutic outcome. Good knowledge of normal movement, human anatomy, neurophysiology, and kinesiology is also a prerequisite to learning this therapeutic program. After a therapist has received actual hands-on training and experience, PNF can be a very effective and efficient for treating patients with many different conditions, such as, neurological diseases, physical trauma, and orthopedic symptoms. The final treatment goal is to reach the highest functional degree and amount of independence for each individual patient. In this review of the PNF therapeutic techniques, the basic principles, patient evaluation, treatment basics, treatment goals, PNF patterns, patient positioning, and therapeutic techniques are described. This variety of approaches helps patients recover and become independent. Many books have been written and published, and a few are included in the bibliography, including one in Japanese.

Key words: Proprioceptive Neuromuscular Facilitation, Rehabilitation Technique, Goal for Independent Living

Proprioceptive Neuromuscular Facilitation (PNF):

PNF was originally conceived and developed at the Kabat-Kaiser Institute in Vallejo, California, USA, from 1946 to 1951 ⁽¹⁾. There were three professionals who worked together to advance this technique and to improve the recovery of voluntary movements in patients with paralysis and/or loss of movements. Included in this endeavor were two physical therapists, Margaret Knott, RPT, Dorothy E. Voss, RPT, and a doctor of physical medicine, Herman Kabat, MD ⁽²⁾. At this time in the field of rehabilitation and physical therapy in America, the development of the theory of “facilitation” for therapy became very popular, and the founders of PNF decided to test this theory and discovered it to be very effective as a therapeutic technique ⁽³⁾.

The literal meaning of PNF:

“Proprioceptive” refers to the body tissues’ reception of stimulation.

“Neuromuscular” refers to the body’s muscles and nerves.

“Facilitation” is “the promotion or hastening of any natural process; the reverse of inhibition”. Included in this definition is “specifically, the effect produced in nerve tissue by the passage of an impulse” ⁽³⁾.

Gradually, the second application of a stimulus causes a smoother reaction of the muscle ⁽³⁾.

Therefore, PNF techniques are methods of promoting or hastening the response of the neuromuscular mechanism through stimulation of the body’s proprioceptors ⁽³⁾.

Definition:

“The PNF philosophy promotes the mobilization of the patient’s reserves through a positive approach toward the total human being during intensive functional training” ⁽³⁾.

Before starting to use PNF:

The therapist should develop a good knowledge of normal neuromuscular mechanisms, anatomy, neurophysiology, and kinesiology to perform PNF effectively and safely.

Basic principles:

Proprioceptive impulses entering the central nervous system from the muscles, tendons, and joints (sensory stimuli) are important in controlling normal voluntary movements. The main goal of PNF is to hasten the recovery of normal function, and inducing muscle contractions is a basic part of the PNF treatment approach.

Muscle contraction strength depends upon the number of motor units activated, so the use of many facilitation mechanisms is necessary to get the strongest muscle contractions ⁽¹⁾. Techniques involving various combinations

of joint movements help stimulate and develop skill, strength and endurance in the human body. Improvement in range of motion, coordination of movement, endurance, posture, and joint stability is also important. Activities of daily living should also be emphasized, because it helps the patient become independent. The reduction of abnormal movement patterns, pain, incoordination, contractures, tightness, and spasticity is stressed. In other words, PNF is used to customize and treat the whole patient, not certain just individual parts of the body.

The first step of the treatment:

A complete evaluation and various tests to determine the treatment goals suiting the patient’s needs and limitations are necessary. The evaluation includes determining and testing the patient’s levels of function and causes of dysfunction. Some of the causes of dysfunction include weakness, paralysis, pain, joint or muscle impairments, sensory deficits, lack of motor control, decrease in endurance, etc.

If the patient cannot tolerate the PNF techniques at first due to pain, etc., other physical therapy procedures, such as electrical modalities, could be included.

Treatment Basics:

The joint movements are done in the full range of motion, and the motion starts from the distal joint and advances to the proximal. Usually all the joints in the limb that are to be stimulated are included. In addition to using various movements, resistance to the movements is a very important stimulus not only to increase strength in muscles but to stimulate the muscle motor units for increasing voluntary movement ⁽²⁾.

In PNF, maximal resistance is generally used to involve not just one muscle but also many muscles in the parts of the body and joints that are being exercised. This resistance is often referred to as “maximal resistance”. Maximal resistance is essentially used to activate the strongest muscle contraction that the patient can tolerate without stopping the voluntary movement of the part. This is an essential part of PNF. However, there are also several special techniques used that involve specific parts of the body.

Treatment goals:

Goals are generally functionally oriented, and the type of muscle contraction desired must be determined before starting the therapy.

PNF patterns:

The patterns are named by the motion of the proximal

joints (i.e., shoulder or hip). The elbow joints may flex, extend, or remain in one position while exercising with the pattern. The patient's hands and fingers move in the motion designated for the pattern used. For normal timing of the movements, the distal part moves first, and then the other parts move together. Rotation of the parts is an integral part of the motion and is usually resisted throughout the movement. The motions are not only in a spiral but also in a diagonal direction, and the line of motion is very close to the body and generally straight. This line is known as the "groove" of the pattern⁽³⁾; for example, the groove line for the upper extremity forms from the top of the shoulder joint to the opposite side of the pelvis (Figures 1 and 2). A movement is started with the limb and muscles to be treated put in the lengthened position, and it ends with the muscle in the shortened range (Figure 3).

As noted above, normal timing of the movement starts with the hand or foot of the desired pattern, and then advances to moving with all the joints involved going together and completely. Changing the movements of the elbow or the knee in the desired pattern can change the effect on the two-joint muscles in the patterns, which can be beneficial, but, at first, it is usual to keep the elbow or knee straight.

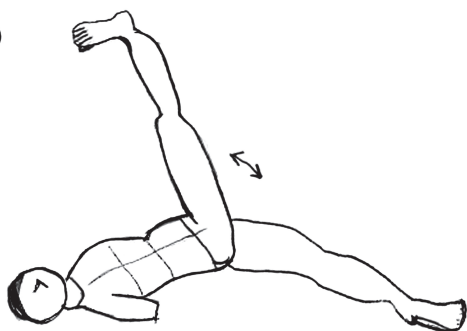
Start the treatment with the uninvolved or least painful

parts. Doing the movements bilaterally may also help the patient move easier. The involved parts should be treated last. This method helps for reinforcement, motor learning, and psychological purposes. Do each pattern 4 to 5 times, but over-fatiguing the patient is not recommended.

Positioning:

To further increase the functional effects of the treatment, the patterns and patient positions can be varied. Please note that the patterns are the basic forms of treatment. Most treatment procedures start with the patient lying on a treatment table or mat, but therapy expands to using the patterns in various positions and for activities of daily living to improve functional abilities. Examples include treating the patient in sitting, rolling, standing, and walking. PNF can be used for all parts of the body, including the face, eyes, mouth, tongue, chest (breathing), etc. The therapist must also be aware of his/her position when performing the PNF techniques in order to apply the proper stimulus to the patient and to avoid injury to the therapist as well.

**A. Flexion-Adduction-External Rotation ⇌ Extension-Abduction-Internal Rotation
(Right Leg)**



**B. Flexion-Abduction-Internal Rotation ⇌ Extension-Adduction-External Rotation
(Left Leg)**

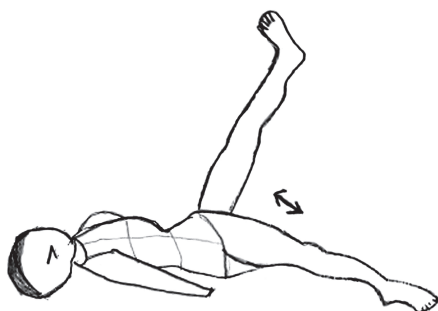


Figure 1: Upper Extremity Antagonistic Patterns

**A. Flexion-Adduction-External Rotation ⇌ Extension-Abduction-Internal Rotation
(Right Arm)**



**B. Flexion-Abduction-External Rotation ⇌ Extension-Adduction-Internal Rotation
(Left Arm)**



Figure 2: Lower Extremity Antagonistic Patterns

1. There are two diagonals of motion for each of the major parts of the body.
2. There are two antagonistic patterns for each diagonal.
3. The movements are done in a diagonal and spiral direction.

UPPER EXTREMITY:

Flexion-Adduction-External Rotation ⇌ Extension-Abduction-Internal Rotation

Flexion-Abduction-External Rotation ⇌ Extension-Adduction-Internal Rotation

LOWER EXTREMITY:

Flexion-Adduction-External Rotation ⇌ Extension-Abduction-Internal Rotation

Flexion-Abduction-Internal Rotation ⇌ Extension-Adduction-External Rotation

Figure 3: PNF PATTERN COMPONENTS

If the patient experiences any PAIN, the treatment is stopped, and changing to a different technique or pattern is recommended.

The main goal of the PNF treatment is for the patient to gain “the highest level of function” possible ³⁾.

The following techniques are also essential parts of the treatment ⁽⁴⁾:

1. Manual Contacts and Timing: The therapist’s hands are placed on the part of the body that is to be moved, where the patient is stimulated to move, and do not interfere with the movement.
A lumbrical grip is used to help the therapist control the patient’s movement by fitting it to the patient’s limb and not squeezing it. Resistance is applied, and the timing of resistance coordinates with the patient’s movement.
2. Patterns of Facilitation: The patterns are normal patterns of movement that are spiral and diagonal and include three components of motion moving at the same time. These motions include flexion or extension, abduction or adduction, and internal rotation or external rotation (Figure 3).
3. Stretch: The muscle to be moved is elongated and a stretch reflex is used to facilitate the contraction and decrease muscle fatigue. The stretch must be followed by resistance to get a good contraction during movement.
4. Verbal Commands: Commands must be clear, concise, and positive. Using the commands to give positive feedback to the patient helps improve the patient’s movement response.
5. Resistance: Resistance is applied to increase strength, improve awareness of motion, and improve motor control and coordination. In applying resistance, it is important to keep the appropriate amount of resistance that still allows the patient to have a smooth and coordinated movement throughout the range of motion. Resistance while the patient is moving in a pattern often causes an overflow of the stimulus to other parts of the body.
6. Traction and Approximation: Traction involves the elongation of the body parts and is used to facilitate movement.
Approximation is the compression of the joint areas to induce stability or postural reactions.
7. Visual Stimulation: The patient must follow the movement of the limb that is moving with the eyes and head.
8. Irradiation/Overflow: This is the spreading of a muscle

response from strong muscle groups to weaker ones to get a stronger reaction and reinforcement in the moving parts.

9. Contra-Indications: Pain or unstable joints are an indication that there may be some tissue damage, and a stretch should not be used in the treatment.
10. Traction and Approximation: Traction is a stretching of the muscles, and it is used to facilitate movements.
Approximation is compression to the joints to increase stabilization and weight-bearing of the limbs.
11. Muscle contraction types:
Isotonic dynamic contraction: concentric is a shortening contraction eccentric is a lengthening contraction.
Isometric contraction: static contraction is done by applying an equal amount of resistance to the movement.

In addition to the above basic techniques ⁽⁴⁾:

There are other special techniques that are also used to enhance the effects of treatment.

1. Rhythmic Initiation: To help the patient initiate and perform the desired functional movement, the therapist first passively moves the limb in one direction slowly and then gradually moves the limb back and forth several times while gradually increasing resistance to obtain an active resisted movement.
2. Combination of Isotonics: To improve coordination, control, and active range of motion, a stabilizing resistance is applied at the end of the patient’s active range of motion. When the movement is stable, the patient repeats the procedure several times without relaxing in-between patterns.
3. Replication: The limb is placed at the end position of the movement pattern and resistance is applied. This technique is used to help the patient understand where the end range of the movement is. This technique is repeated several times with the limb moved slightly further back each time to help the patient move through a greater range of motion.
4. Dynamic Reversal of Antagonists: The desired pattern is performed with resistance, and then the reverse pattern in the opposite direction is performed with resistance. This technique may be repeated as often as necessary to get the necessary result.
5. Rhythmic Stabilization: Resistance is gradually applied to the desired pattern, but no movement is allowed. When the patient fully resists, resistance is then applied in the opposite direction with one hand. This pattern can be repeated as often is necessary, if the patient can

tolerate it.

6. Repeated Stretch: When the patient starts to move in the pattern desired, a quick stretch is applied to lengthen the muscles further and to facilitate the stretch reflex. As a quick stretch is applied to the limb, the patient is asked to move in the desired pattern as resistance is also applied. The quick stretch can be used throughout the pattern.
7. Timing: Normal timing of a pattern is to have the body part moving from the distal part to the proximal part. Timing for emphasis changes normal timing by only allowing the weaker part of the pattern move while resisting the stronger muscles.
8. Repeated contractions: To help the patient learn the movements, develop strength, and increase endurance, repeating the contractions till fatigue occurs can be quite useful, especially when it is used for weaker muscles.
9. Contract-Relax: When there is a limitation in the range of motion, the limb that is limited is moved to the point of limitation in the desired pattern. Then the patient's limb is resisted in the opposite pattern for a few seconds, with only enough movement to mostly elicit rotation of the joint. The patient then relaxes, and the limb is resisted towards the new range of motion. This procedure is repeated several times to gain as much new range of motion as possible.
10. Hold-Relax: This technique is similar to contract-relax, but no movement is required while the patient's limb is resisted in the opposite direction. This procedure is often used when the patient experiences pain with other procedures.
11. Not all the techniques are used all the time. There are many techniques, because there are many patients who have various diagnoses and limitations and need therapy that is suited to their needs. Therefore, the therapist has a wide diversity of approaches to use as

needed (3).

The philosophy and techniques of PNF as listed above have been used for over 70 years and have been shown to be very effective in treating many different types of patients with varied diagnoses. There are many variations included in the PNF techniques, and it may seem very complicated to therapists who have never received any personal instruction or have not attended any instructional courses. However, once the therapist has had actual hands-on instruction and experience, PNF can be found to be very efficient to use and very effective in treating patients with various conditions. As noted above, PNF has been used for over 70 years and is still being used in many countries all over the world, including Japan.

Good luck!!!

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固有受容性神経筋促通療法の紹介！

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抄 録

固有受容性神経筋促通法 (PNF) は、身体運動制御に欠陥を示す患者に対して随意コントロールを回復させる有効な治療法としてリハビリテーションで利用されている。現在、この治療手技は世界的に知られ、使用されていますが、70 年以上前に初めて開発された時には、今までの治療概念と全く異なった驚きの治療技術でした。PNF は難解かつ複雑なプログラムで構成されており、効果的な治療結果を発揮させるためには、その手技の実践者への詳細な指導が必要とした。人の正常な運動、人体解剖学、神経生理学、運動学に関する十分な知識がこの治療プログラムを学ぶための前提条件であった。さらにこの PNF を実施するセラピストは、トレーニングを指導者から伝授されて実践的な経験を積みその訓練の結果、PNF は神経疾患、身体外傷、整形外科的症候などの様々な症状を持つ患者の治療に非常に有効で効率的な治療法となり得た。この PNF による究極の治療目標は、個別の患者の機能と自立度を最大限に高めることである。本総説では、PNF 治療法の基本原理、患者評価、治療の基本、治療目標、PNF パターン、患者のポジショニング、治療法について解説している。この多様性のあるアプローチは、患者さんの回復と自立を支援している。多くの書籍が執筆・出版されていますが、日本語の書籍を含めて一部を参考文献として示します。

キーワード：固有受容性神経筋促通法，リハビリテーション技術，自立生活の目標