Proprioceptive Neuromuscular Facilitation in the Orthopedic Practice

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Program Description

- Lecture/Lab Course
- Neurophysiology of PNF
- Principles of PNF
- Techniques of PNF
- PNF in the outpatient orthopedic setting
- Early post-op to highly skilled
Learning Objectives

- Learn about the techniques and principles of PNF
- Differentiate between stretching and strengthening patterns.
- Learn how to incorporate PNF into your treatment plans.
- Differentiate when to use the various techniques depending on patient presentation.
- Demonstrate proper biomechanics administering PNF.

Learning Objectives cont’d

- Appreciate the sensation of how proper contacts and inputs can facilitate motion or stabilization of a joint depending on the desired response of the therapist.
- Develop a treatment plan based on the evaluation of motion, strength, stabilization, relaxation, increased tone, decreased tone, based on feedback given by PNF.
- Be able to incorporate techniques and ideas reviewed today with your patients on Monday.
Agenda

- Introduction to PNF
- Principles of PNF
- Techniques of PNF
- Review of Upper Extremity Anatomy relative to involvement with UE patterns
- UE linear Patterns
- UE Diagonal Patterns
- UE early post-op case

Agenda cont’d

- UE - higher functional level case
- Review of LE anatomy as related to LE patterns
- LE linear patterns
- LE spiral patterns
- LE -early post-op case
- LE higher functional level case.
- Review of pelvic anatomy relative to pelvic patterns
Agenda cont’d

- PNF with gait.
- Special Considerations.
- Discussion.

History of PNF

- In the 1940’s Kabat and Knott began this philosophy/concept of treatment.
- Later Voss joined in and in 1956 the first book on PNF was published.
- Initially used for clients with MS and poliomyelitis and then it was expanded.
- Has been a part on PT curriculum for years.
Kabat 1950

• PNF is a concept of treatment. It’s underlying philosophy is that all human being, including those with disabilities have untapped existing potential.

• PNF is an integrated approach directed toward the whole human being not a specific body segment or problem.

• Based on utilizing the patient’s reserves and used in a positive manner based on what the patient can do physically and psychologically.

• Integrates motor control and motor learning.

Kabat cont’d

• Goal- Achieve the patient’s highest level of function.

• No pain, achievable tasks, set up for success, direct and indirect treatments to assist this.
Knott

• PNF- “Methods of promoting or hastening the response of the neuromuscular mechanism through stimulation of the proprioceptors.”

Sullivan, Markos, Minor

• Direct Approach: The application of exercise techniques and elements to the affected area.

• Indirect Approach: The application of exercise techniques and elements to an uninvolved area to gain overflow excitation or relaxation effects of the affected part. An indirect approach is appropriately used when the patients involved limbs are either immobilized, weak, or painful.
Neuromuscular Re-Ed vs. Strengthening

Advantages

- Feel what is going on
- Evaluative as well as rehabilitative. Identifies stability, neuromuscular control, coordination of movement, and endurance.
- Functional
- Accommodative
- Inexpensive

Advantages cont’d

- Rotational components
- Isometric/Isotonic
- Concentric/eccentric
- Stimulates proprioceptors
- Enhances patient/therapist relationship
- Physical Therapy Specific
- Enhances creativity in treatment programs
- Recruitment of entire kinetic chain to facilitate a specific muscular pattern or dysfunction.
Disadvantages and Myths

Disadvantages
No recording devices.

Myths
Physically taxing
Time Consuming

PNF
- Get active participation from the patient
- Incorporate motor learning and motor control
- Self training using principles of repetition
- Repetition is the mother of skill.
- Once that pattern is learned - repeat it with pulley systems, weights, t-bands, and HEP movement patterns.
All sensory and cognitive processes may be viewed as inputs that determine future motor outputs.

After injury, without proper cognitive and sensory input the patient is severely limited in mastering new tasks.

Cues form the therapist are vital in first stages of motor learning because the patient can no longer trust their internal information as it has been damaged.

PNF allows the PT to become an important source of the external information to the patient.

After discharge- The effect of a stimulus continues after the stimulus stops. If the strength and duration of the stimulus increases, the after discharge increases.

Temporal summation- A succession of weak stimuli occurring in a short period of time combined cause excitation.

Spatial summation- weak stimuli applied simultaneously to different areas of the body reinforce each other to cause excitation.
Sherrington cont’d

- Irradiation- This is a spreading and increased strength response. It occurs when the either the number or strength of the stimuli is increased. The response may be excitation or inhibition.

- Reciprocal Inhibition- Contraction of muscle is accompanied by simultaneous inhibition of their antagonists. This is a necessary part of motion.

Reciprocal inhibition

- Stretch of the knee extensors (quadriceps muscle) inhibits knee flexors (hamstrings)
- Ia (fast conducting) afferents activate interneurons that inhibit (hyperpolarize) α motor neurons innervating hamstrings
- Functional significance: Coordination of antagonists - hamstrings are relaxed when quadriceps contracts
PNF

- **Proprioceptive**: Having to do with any of the sensory receptors that give information concerning movement and position of the body. Includes manual contacts, verbal commands, and vision.

- **Neuromuscular**: Involving the nerves and muscles.

- **Facilitation**: making easier.

PNF

- **Facilitory**: Impulses causing the recruitment or excitement and discharge of additional motor neurons in the spinal cord. Results in increased excitement in the muscles. Helps with weakened muscles.

- **Inhibitory**: Any stimulus that causes motor neuron discharge to diminish. Results in decreased excitability of the motor neurons. Muscle tightness or spasticity can be decreased.
Principles of PNF

- **Stimulates Proprioceptors**: Muscle Spindles, golgi tendon organs, joint receptors
- **Irradiation and Reinforcement**: Overflow to other areas of the body
- **Pain-Free**: Performed through pain free patterns.
- **Relaxation/Stretching**: Prior to Strengthening
- **Uses diagonal/spiral patterns of motion**: Joint integrity is enhanced by emphasizing rotatory component.

Principles cont’d

- **Manual Contacts**: Placement of hand in the desired motion.
- **Stretch Reflex**: Stimulus to muscle spindles, Golgi tendon organs, and joint receptors. Not always indicated with orthopedic problems.
- **Commands and Communication**
  - Verbal - motivation
    - **Volume**: Louder = stronger contraction
    - **Softer + calmer**: to cause relaxation.
  - Three parts: Preparation, action, correction.
Principles cont’d

• Verbal (cont’d)
  Commands used- “hold”, “push”, “pull”, “relax”
  Commands attention form the patient.

• Visual- Reinforcement. Have the patient follow the movement of the extremity with their eyes which adds more sensory stimuli and reinforces the pattern.

Principles cont’d

Traction

• Elongation of the trunk or extremity
• Proximal to distal
• Usually performed against gravity
• Separation of joints
• Superimposed upon contractions
• Facilitates strength and motion
• Stimulates alpha motor neurons
Principles cont’d

**Approximation**

- Compression of the trunk or extremity
- Usually performed with gravity
- Compression of Joint surfaces
- Superimposed upon isotonic or isometric contractions
- Stimulates the joint receptors
- Promotes stabilization

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Principles cont’d

**Normal timing**

- Sequencing of contraction of major muscle components
- Distal to Proximal
- Timing for emphasis
- Combining patterns
**Principles Cont’d**

**Resistance**
- Dependent upon proper input by the therapist.
- Depends on proper manual contacts, cooperation of patient
- Appropriate overload and understanding of movement
- Facilitate the movement
- Increase motor control
- Help patient gain awareness of the motion and direction

**Principles cont’d**

**Body Position and Body Mechanics**
- The therapist must be in the line of desired motion.
- Shoulder and pelvis face the direction of movement.
- Therapist stands in straddled fashion
- Resistance comes from the PT’s body with arms relaxed and used as receptors.
PNF Techniques

- **Contract/relax (direct)** - Isotonic activation of antagonist followed by relaxation
- **Contract/relax (indirect)** - Isotonic contraction of the synergistic muscles or agonist muscles.
- **Hold/relax (direct)** - Isotonic contraction antagonist followed by relaxation.
- **Hold-relax (indirect)** - Isotonic contraction of synergistic or agonist muscles.

*Input from the Golgi tendon organ can cause inhibitory postsynaptic potentials to occur on the alpha motor neuron.*
PNF Techniques cont’d

- **Rhythmic Stabilization** - Isometric contractions between antagonist and agonist muscles.
- **Stabilizing Reversals** - Permitting small isotonic contractions between agonist and antagonist muscles.
- **Rhythmic Initiation** - Rhythmic motion of the limb through the desired range, starting with passive motion and progressing to active resisted motion.
- **Slow Reversals** - (Dynamic reversals or Reversal of antagonists) - action motions changing for agonist to antagonist without pause - mimics real-life movements.
- **Slow Reversal/ Hold** - Slow reversals with an isometric hold at the end of the agonist motion to increase output in the antagonist motion.
- **Repeated Contractions/Stretch** - Move through a pattern pausing, applying a quick stretch, press through more motion, pause, quick stretch, push. Emphasizes strengthening in specific ranges throughout the motion.
- **Combination of Isotonics** - Combination of concentric, stabilizing, and eccentric contractions through agonist motion.
PNF Techniques cont’d

- **Timing for emphasis**: Normal Timing of most coordinated and efferent motions is from distal to proximal. Timing for emphasis is changing the normal sequencing of motions to emphasize a particular muscle or desires activity.

Functional Progression

- **Mobility**: Ability to initiate a movement.
- **Stability**: Stabilize a new static position and control gravity.
- **Mobility on Stability or Controlled Mobility**: Make movements in a stable position or with a stable base.
- **Skill**: Manipulate the environment with dynamic, proximal stability.
Designing a Treatment Plan

- Utilizing all these principles and techniques in your treatment plan.
- Direct vs. indirect treatment
- Appropriate activities - motion/stability, type of contractions.
- Best position for the patient - comfort, security, effect of gravity, two-joint muscles groups, use of vision, closed vs open kinetic chain.
- What techniques to use.

Treatment Plan cont’d

- Patterns and combinations of patterns
- Functional and goal oriented tasks needed.
- Use your evaluation to determine all these areas - where is the dysfunction, weakness, tightness, instability, etc.
- Use PNF in the evaluative process - gives you immediate feedback feeling changes in muscular output, coordination, soft tissue restrictions, etc. Use this in your assessment for reaction to treatment and continually progress. Will help adapt your supplemental exercises and HEP.
The Upper Extremity

D1 Flexion

- Motions—what is happening at the proximal joint—shoulder.
- Flexion/Adduction/External Rotation
- Scapula—rotation, elevation—serratus anterior
- GH Jt—flexion, adduction, IR—pec major anterior deltoid, coracobrachialis, biceps brachii.
- Elbow/forearm—flexion and supination—biceps brachii, brachialis, supinator.

D1 Flexion cont’d

- Wrist—flexion, radial deviation—wrist flexors
- Fingers—finger flexors
Manual Contacts D1F UE

- **Distal Hand**: palm of the patients hand.
- **Proximal Hand**: anteromedial aspect of the brachial region

D1 Extension- Ext/ Abd/ IR

- **Scapula**: rotation, adduction, posterior depression- levator scapula, rhomboids.
- **GH jt**: Extension, Abduction, IR- Teres major, lat dorsi, post delt, triceps.
- **Elbow/forearm**: extension, pronation- triceps, anconeus, pronator teres, pronator quadratus
- **Wrist**: wrist/finger extension, ulnar deviation- wrist and finger extensors.
- **Fingers**: extension- finger extensors.
Manual Contacts D1E UE

- **Proximal Hand**: Palmar surface of the hand cupped around the dorsal ulnar aspect of the wrist and fingers.
- **Distal Hand**: Palmar surface on posterolateral surface of brachial region.

D2 Flexion- Flex/ Abd/ ER

- **Scapula**: Rotation, adduction, post elevation- whole trapezius, levator scapula.
- **GH Jt**: Flexion, abduction, ER - teres minor, supraspinatus, infraspinatus, middle deltoid
- **Elbow/Forearm**: Extension, forearm supination- triceps brachioradialis, biceps brachii, supinator.
- **Wrist**: Extension, ulnar deviation- wrist extensors
- **Fingers**: Extension- finger extensors.
Manual Contacts for D2F UE

- **Proximal Hand**: Palmar surface of hand cupped over dorsal-radial aspect of the patient’s fingers and wrist.
- **Distal Hand**: Palmar surface on anterolateral aspect of the Brachial region.

D2 Extension- Ext/Add/IR

- **Scapula**: rot, abd, ant dep- pec minor, subclavius.
- **GH Jt**: ext, add, IR- pec major, subscapularis
- **Elbow/forearm**: extension, forearm pronation- triceps, pronator teres and pronator quadratus.
- **Wrist**: flexion, radial deviation- wrist flexors
- **Fingers**: flexion- finger flexors.
Manual Contacts for D2E UE

- **Distal Hand**: Palm of the patient’s hand.
- **Proximal Hand**: Palmar surface on the posteromedial aspect of the brachial region.

The Lower Extremity

**D1 Flexion**

- What is happening at the proximal joint - the hip.
- **Hip**: Flex, add, ER - iliopsoas, adductors, sartorius gracilis, Rectus femoris,
- **Knee**: Extension - tibial ER - quadriceps, articularis genu.
- **Ankle/foot**: DF, inv - anterior tibialis
- **Toe**: ext, abd, tibial side - toe extensors
Manual Contacts for D1F LE

- **Distal**: Dorsomedial aspect of the foot.
- **Proximal**: Anteromedial aspect of the distal thigh, proximal to the patella over the VMO.

D1 Extension- Ext/Add/IR

- **Hip**: extension, abduction, IR: Gluteus medius/minimus, biceps femoris, popliteus, GS: lateral head.
- **Knee**: Extension, tibial IR: quadriceps, articularis genu
- **Ankle/foot**: Plantar flexion, eversion: Lateral GS, Peroneals,
- **Toes**: toe flexors.
Manual Contacts for D1E LE

- **Distal**: Plantar-lateral aspect of the foot and toes.
- **Proximal**: Posterolateral aspect of the thigh proximal to the popliteal space.

D2 Flexion- Flex/Abd/IR

- **Hip**: Flexion, abd, IR- TFL, lateral rectus, iliopsoas.
- **Knee**: Extension, tibial IR- quadriceps femoris, articularis genu
- **Ankle/foot**: Dorsiflexion/Eversion- anterior tibialis, peroneals,
- **Toes**: toe extensors.
Manual Contacts for D2F LE

- **Distal**: Dorsolateral aspect of the foot.
- **Proximal**: Anterolateral aspect of the thigh proximal to the patella.

D2 Extension- Ext/Add/ER

- **Hip**: Ext, add, ER- Gluteus max, Piriformis, Add Magnus, Semitendinosus, Semimembranosus.
- **Knee**: ext, tibial ER- Quadriceps Femoris, Articularis genu
- **Ankle/Foot**: PF, Inv- GS-medial head,
- **Toes**: Toe flexors
Manual Contacts for D2E LE

- **Distal**- Plantar medial aspect of the foot and toes.
- **Proximal**- Posteromedial aspect of the thigh proximal to the popliteal space.

Questions/Discussion
Thank you