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Using PNF to Improve Upper Extremity and Trunk Function

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Disclosures

- Financial
  - Dr. Hickman teaches continuing education courses in PNF
Course Objectives

- After this course, participants will be able to…
  - Describe PNF Philosophy and Basic Principles
  - Describe typical trunk responses during upper extremity and scapular PNF patterns/diagonals
  - Identify and describe intervention strategies incorporating PNF for common body function/structure deficits and activity limitations to improve UE function and ADL performance

Agenda

- Trunk analysis
- Introduction to Proprioceptive Neuromuscular Facilitation (PNF)
- PNF Interventions
- Integration of PNF Interventions into Practice
- Summary
- Q&A
Trunk Analysis

What is the “trunk”? 
What is the “trunk”?

Is it the same as the “core”?

What is the Trunk?

- “The definition of trunk is inconsistent. The word may refer to all body segments between the base of the neck and the hip joints (except the arms) or represent just the lumbar and thoracic segments.”

Perry and Burnfield
What is the Trunk?

- Upper Trunk
  - Thorax

- Lower Trunk
  - Lumbopelvic region
What is the role of the trunk during functional tasks or activities?

- Mobility
- Stability
- Controlled Mobility
Mobility: Rolling

Stability: Static Sitting

Controlled Mobility: Sit to Stand, Seated Reaching

What do we know about the trunk?

- Less active in presence of low back pain
- Trunk stability exercises improve low back pain
- Trunk interventions improve UE function, sitting/standing balance, and gait in patient’s post-stroke
- Trunk strengthening can reduce risk for aspiration pneumonia

**Improved Trunk = Improved Function**
Postural Observation and Movement Analysis

Postural Observation

- Lower Trunk
  - Ant/Post Tilt
  - Weight-Bearing
  - Elevation/Depression
  - Rotation
- Upper Trunk
  - Flexion/Extension
  - Shortening/Lengthening
  - Rotation
  - Shift
Lower Trunk
- Ant/Post Tilt
- Elevation/Depression
- Rotation
- Weight-Bearing

Upper Trunk
- Flexion/Extension
- Shortening/Lengthening
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Lower Trunk
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Elevation?

Post. Tilt
Lower Trunk

- Ant/Post Tilt
- Elevation/Depression
- Rotation

Elevation?  

Elevation?  
Post. Tilt
Lower Trunk
- Ant/Post Tilt
- Elevation/Depression
- Rotation
- Weight-Bearing

Upper Trunk
- Flexion/Extension
Lower Trunk
- Ant/Post Tilt
- Elevation/Depression
- Rotation
- Weight-Bearing

Upper Trunk
- Flexion/Extension
- Shortening/Lengthening
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Lower Trunk
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Upper Trunk
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- Rotation
- Shift
Lower Trunk
- Ant/Post Tilt
- Elevation/Depression
- Rotation
- Weight-Bearing

Upper Trunk
- Flexion/Extension
- Shortening/Lengthening
- Rotation
- Shift

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Does the trunk look active or engaged?
- Rolling video

- Sit to stand video
What did we see?

- Left upper trunk rotation
- Left upper trunk shortening
- Consistent posterior pelvic tilt
- Limited lower trunk rotation
- Limited left weight bearing

Multiple deficits carried through different positions/tasks

Introduction to PNF

History
Philosophy
Basic Principles

PNF Patterns
PNF Techniques
What is PNF?

History of PNF

- Originally developed by Dr. Herman Kabat and Maggie Knott in the 1940s
- Further expanded in 1947 when Dr. Kabat at Ms. Knott moved to the Kaiser Hospital in Vallejo, California
- Patients with Multiple Sclerosis and polio were main type of patients being treated at this time, but slowly the benefits of PNF were seen with a wide variety of diagnoses
- A residency program at Kaiser Vallejo was created to train therapists
- Currently 3-, 6-, and 9- month long residencies are available for physical therapists
PNF Philosophy

1. Everyone has potential
2. An integrated approach that addresses whole person
3. A positive approach that focuses on what the patient/client **can** do
4. Interventions must be toward a specific functional goal
5. Incorporates the use of stronger body parts to strengthen weaker ones
6. Facilitate a maximal response
7. Use repetition to promote motor learning
8. An intensive program is required to promote the best outcome
9. Optimize function

What is PNF?

**A method to assess and improve the efficiency and effectiveness of human movement and function**
How is PNF performed?

PNF Basic Principles

1. Patient Position
2. Manual Contacts (Lumbrical Grip)
3. Therapist Position/Body Mechanics
4. Appropriate “resistance”
5. Traction and Approximation
6. Quick Stretch
7. Irradiation
8. Normal Timing
9. Patterns of Facilitation
10. Visual Input
11. Verbal Input

These are tools used to enhance a treatment
PNF Basic Principles

Patient Position
- Consider affect of gravity
- Consider treatment goal

Manual Contacts
- Lumbral grip – “Mitten hands”
- Allows for comfortable, specific contact

PNF Basic Principles

Therapist Position
- Place body in the line of the movement
- Maintain good body mechanics
- Must move with the patient through the desired movement

Appropriate Resistance
- Amount of resistance that results in a smooth, coordinated movement or motor response
- Can use concentric, eccentric, isometric contractions

Sometimes the appropriate resistance is **ASSISTANCE**
PNF Basic Principles

Traction
- Facilitates movement
- Helps reduce fatigue during anti-gravity movements

Approximation
- Facilitates stability
- Used with pushing or weight-bearing activities

*Traction video
*Approximation video

PNF Basic Principles

Quick Stretch
- Used to initiate or increase motor activation during a movement
- Can be performed on elongated tissue, or actively contracting tissue

*Quick stretch on contracting tissue video
*Quick stretch on elongated tissue video
PNF Basic Principles

- Irradiation
  - Creates an overflow over motor recruitment into areas not directly being used
  - Allows for use of one body part/segment to recruit another
    - Using a stronger body part to influence a weaker one

  (Reznik 2015, Hendy 2012)

- *Irradiation video

PNF Basic Principles

- Normal Timing
  - Consider how a movement should be performed
  - Proximal stability develops before distal
  - In open chain, adults normally initiate movements distally to proximally
  - In closed chain, proximal segments initiate over distal
PNF Basic Principles

Visual input
- Use of vision on target helps to integrate head/trunk
- Provides cues to direction of movement
- Increases motor response

Verbal input
- Can modulate voice to adjust a response
  - Quick/fast command vs slow/quiet
- Use of a preparatory command
- Use of positive feedback

PNF Techniques

Rhythmic Initiation
- Replication

Dynamic Reversals
- Combination of Isotonics
- Stabilizing Reversals

Quick Stretch
- On Contracting Tissue
- On Elongated Tissue

**Used to teach or enhance a movement or pattern**
PNF Techniques

Rhythmic Initiation
Used to teach a pattern or movement
Passive -> Active Assisted -> Active -> Resisted
Start at beginning of range, moving towards end of range
Indications
- Teaching the pattern/movement
- Helping patient relax
- Improving coordination of movement/pattern

*Rhythmic Initiation video

Replication
Used to teach the pattern
Start at end of range with a hold
After hold, patient will relax and is moved towards beginning of pattern
Move in small increments each repetition to beginning of pattern
Indications
- Teach the pattern/movement
- Assess strength at end range of pattern/movement

*Replication video

PNF Techniques

Dynamic Reversals
Movements are performed against resistance in both directions of a task without stopping
Indications
- Decrease fatigue of particular muscle group
- Improve strength

Speed and amount of resistance can change at any time based on need

Dynamic reversals video

Combination of Isotonics
Combines concentric and eccentric components of a pattern or movement
Agonist is always active
Indications
- Improve strengthening
- Improve coordination
- Improve endurance

Careful – this technique is very demanding on both therapist and patient
*COI video
PNF Techniques

Stabilizing Reversals
- Alternating muscle contractions against resistance at a generally stable position

Indications
- Promote stability and strength
- Improve coordination

PNF Patterns

What are D1 and D2?

Patterns are named for the position they end in
Each diagonal has two patterns associated with it

Upper and Lower Extremity Patterns
Scapular and Pelvis Patterns

Remember typical trunk responses!
Trunk Extensor Response

- D1 Flexion
  - Shoulder Flex/ADD/ER
  - Wrist Flex
  - Finger Flex
- D2 Flexion
  - Shoulder Flex/ABD/ER
  - Wrist Ext
  - Finger Ext

Shoulder Pivot

- Shoulder ADD
- Wrist Flex
- Finger Flex

Shoulder Ext/IR

Trunk Flexor Response

- D2 Extension
  - Shoulder Ext/ADD/IR
  - Wrist Flex
  - Finger Flex
- D1 Extension
  - Shoulder Ext/ABD/IR
  - Wrist Ext
  - Finger Ext

Upper Extremity Patterns

Flexion-Abduction-External Rotation Ending position
- Indications
  - Over head reaching
  - Thoracic extension
  - Upright posture

Extension-Adduction-Internal Rotation Ending position
- Indications
  - Rolling
  - Throwing
  - Bed mobility
Upper Extremity Patterns

Flexion-Adduction-External Rotation ending position
- Indications
  - Self-feeding
  - Reaching across body

Extension-Abduction-Internal Rotation ending position
- Indications
  - Functional stabilization
  - Hygiene
  - Push off for sit to stand
  - Sitting balance with UE support

Trunk Flexor Response
D1 Flexion
- Hip Flex/ADD/ER
- Ankle DF/Inv
- Toe Ext

D2 Flexion
- Hip Flex/ABD/IR
- Ankle DF/Ev
- Toe Ext

D2 Extension
- Hip Ext/ADD/ER
- Ankle PF/Inv
- Toe Flex

Trunk Extensor Response
D1 Extension
- Hip Ext/ABD/IR
- Ankle PF/Ev
- Toe Flex

Hip ADD/ER
- Ankle Inversion

Hip ABD/IR
- Ankle Eversion
Lower Extremity Patterns
Paired Patterns

Flexion-Adduction-External Rotation Ending position
- Indications
  - Lower body dressing
  - Trunk flexor activation

Extension-Abduction-Internal Rotation Ending position
- Indications
  - Sit to stand
  - Standing balance

Lower Extremity Patterns
Paired Patterns

Flexion-Adduction-Internal Rotation ending position
- Indications
  - Trunk shortening
  - Stepping into car/tub
  - Lower body dressing

Extension-Adduction-External Rotation ending position
- Indications
  - Lower body dressing
Scapular Patterns

Scapular patterns named for position they end in
- Anterior-Posterior to midline
- Elevation-Depression from neutral

Patterns will always cross midline

Scapular Clock
- Usually diagonals are close to midline
  - 11:00 <-> 5:00
  - 1:00 <-> 7:00

Are connected with Upper Extremity Patterns

Scapular Patterns

Anterior-Elevation
- **Functional Applications**
  - Rolling
  - Trunk elongation
  - Very good for upward rotation of scapula for overhead reaching

UE Pattern: Flex-Add-ER

Posterior-Depression
- **Functional Applications**
  - Weight bearing stability for UEs
  - Trunk shortening
  - Trunk extensor activation
  - Sit to stand
  - Eccentric during overhead activity to control scapula

UE Pattern: Ext-Abd-IR
Scapular Patterns

Anterior-Depression

- **Functional Applications**
  - Very strong connection to trunk flexors
  - Trunk shortening
  - Trunk Stability
  - Flexion Rolling

Posterior-Elevation

- **Functional Applications**
  - Overhead reaching
  - Trunk elongation
  - Strong connection to trunk extensors

UE Pattern: Ext-Add-IR

UE Pattern: Flex-Abd-ER

Pelvic Patterns

Exactly the same as Scapular Patterns

Named for position they end in
- Anterior-Posterior to midline
- Elevation-Depression from neutral

Patterns will always cross midline

Scapular Clock
- Usually diagonals are close to midline
  - 11:00 <-> 5:00
  - 1:00 <-> 7:00

Pelvis is a fixed structure
- Ex: Elevation on one side will cause depression on opposite

Connected with LE Patterns
Pelvic Patterns

Anterior-Elevation

Functional Applications
- Swing phase of gait
- Flexion Rolling
- Trunk shortening
- Trunk flexor activation

Manual contact
- Anterior iliac crest superior to ASIS

LE Pattern: Flex-Add-ER

Posterior-Depression

Functional Applications
- Stance stability
- Trunk elongation
- Contralateral trunk shortening

Manual contact
- Ischial tuberosity

LE Pattern: Ext-Abd-IR

PNF Interventions
Prone on Elbows

**Manual Contacts**
- Inferior angle of scapula (traction)
- Spine of the scapula (approximation)
- Posterolateral aspect of head (traction)

**Indications**
- Scapular protraction
- Thoracic extension
- Cervical extension
- UE weight bearing
- Trunk shortening/lengthening

Can be performed as holds, stabilizing or dynamic reversals, combination of isotonics

Can incorporate with movement (turning towards one side) or statically

Use wedge or modify to seated position if not strong enough to stabilize shoulder
Mass Flexion

**Manual Contacts**
- Anterior shoulder near coracoid process
- Anterior-superior pelvis (above ASIS)

**Patient Position**
- Sidelying

**Action**
- Trunk shortening and flexion

*Mass flexion video

**Indications**
- Increasing trunk flexor activation
  - Forced expiration (Coughing)
  - Improved swallowing?
- Forwards Rolling
- Coordinating upper and lower aspects of trunk

Mass Extension

**Manual Contacts**
- Posterior superior shoulder
- Ischial tuberosity

**Patient Position**
- Sidelying

**Action**
- Elongation and extension of trunk

*Mass extension video

**Indications**
- Increased trunk extensor activation
  - Expiration
- Thoracic extension
- Backwards Rolling
Hooklying Stabilizing Reversals

Stabilizing Reversals
- Can be performed on any body part, segment, pattern, or movement
- Alternating direction of resistance against a static position

Indications
- Activating trunk stabilizers
- Bilateral activation
- Irradiation
  - Stronger side to weaker
  - Proximal activation (neck pain)

*Hooklying stabilizing reversals video

Seated Stabilizing Reversals

Manual Contacts
- Anterior contact on coracoid process
- Posterior contact on inferior angle of scapula

Indications
- Irradiation to LEs
- Trunk stability
- Proximal stability prior to movement

*Seated stabilizing reversal video
Integrating PNF into Practice

ICF Model

- Health condition (disorder or disease)
  - Body Functions and Structures
  - Activities
  - Participation
    - Environmental Factors
    - Personal Factors
PNF Philosophy

1. Everyone has potential
2. An integrated approach that addresses whole person
3. A positive approach that focuses on what the patient/client CAN do
4. Interventions must be toward a specific functional goal
5. Incorporates the use of stronger body parts to strengthen weaker ones
6. Facilitate a maximal response
7. Use repetition to promote motor learning
8. An intensive program is required to promote the best outcome
9. Optimize function

What is the goal?
What are the activity limitations?
What are the body function/structure deficits
What CAN the patient do?
WHY?

Lower Trunk
- Ant/Post Tilt
- Elevation/Depression
- Rotation
- Weight-Bearing

Upper Trunk
- Flexion/Extension
- Shortening/Lengthening
- Rotation
- Shift
## Interventions

**Movement Deviations**

### Inactive sitting posture
- Poor postural activity/flexed posture

**Difficulty rolling**
- Left upper trunk lags behind
- Poor trunk flexor activation

**Poor timing for sit to stand**
- Early knee extension
- Posterior pelvic tilt causing limited anterior weight shift

**PNF Interventions**
- Mass Extension, seated stabilizing reversals, prone on elbows
- Scapular Anterior-Depression
- Mass Flexion
- LE Extension-Abduction
- Pelvic Anterior-Elevation

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## Example

- 78 y/o male presented to ED 3 days prior with altered mental status, shortness of breath, and difficulty walking. Found to have dehydration and pneumonia.

**Examination:**
- Vitals: At rest HR 86 bpm; RR 18 with excessive accessory muscle usage; BP 134/84; SaO2 97% on RA
- Cognition: AOx4, follows simple and complex commands
- Strength: Grossly 3+/5 except 2+/5 in bilateral hip extensors and abductors

**Functional Movements:**
- Supine to sit: Mod I, but difficult
- Sitting balance: Static sitting=good, dynamic sitting balance=poor (needs to hold bed rail to keep balance)
  - Tips posteriorly when donning shoes/pants while seated
- Sit to stand from toilet: Mod A with FWW. Poor anterior weight shift, pushes off with BUEs with shoulders remaining elevated
- Standing balance: CGA with FWW. Able to stand with single UE support, but unable to remove both hands
What are possible interventions?

<table>
<thead>
<tr>
<th>Interventions</th>
<th>PNF Interventions</th>
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<tbody>
<tr>
<td>Movement Deviations</td>
<td>PNF Interventions</td>
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<tr>
<td>Poor sitting posture/balance</td>
<td>Mass Extension, UE Flexion-Abduction-ER</td>
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<tr>
<td></td>
<td>- Thoracic kyphosis, posterior pelvic tilt</td>
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<tr>
<td></td>
<td>- Falling posteriorly during LBD</td>
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<td>Poor sit to stand strength</td>
<td>- Pelvic Anterior-Elevation</td>
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<td>- LE Flexion-Adduction-ER</td>
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<td>- UE Extension-Abduction-Internal Rotation,</td>
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<td></td>
<td>Scapular Posterior-Depression</td>
</tr>
<tr>
<td></td>
<td>- Pelvic Anterior-Elevation, LE Extension-Abduction-Internal Rotation</td>
</tr>
</tbody>
</table>
Example

- 25 y/o male was brought to ED after a MVA 5 days ago. Sustained C7-T2 fractures and cord contusion. Underwent surgery for stabilization C5-T4. Currently C7 AIS C and wearing an Aspen Collar.

- Examination:
  - Pain: 6/10
  - Vitals: HR 76; BP 110/72; RR 20; SaO2 100%
  - Cognition: AOx4. Quiet voice, difficulty clearing throat
  - Strength: Tricep 3/5, Grip 2+/5; Bicep 5/5; Shlid Flex/Abd/lR/ER 5/5

- Functional Movement:
  - Rolling: Total A
  - Supine to sit: Total A
  - Sitting balance: Poor, requires constant assistance. Immediately loses balance upon trying to move bilateral UEs
  - Transfers: Total A. Poor lift off, scapulas remain elevated

What are possible interventions?
Interventions

Movement Deviations

Poor diaphragm usage, weak abdominals
  • Vocal quality
  • Difficulty clearing throat

UE and trunk weakness
  • Poor mobility
  • Poor sitting balance

PNF Interventions

• UE Extension-Adduction-IR
• UE Extension-Abduction-IR

• UE Extension-Adduction-Internal Rotation
• UE Extension-Abduction-Internal Rotation
• UE Flexion-Adduction-External Rotation
• UE Flexion-Abduction-External Rotation
• Scapula Posterior Depression

Example

• 64 y/o female with L CVA 2 weeks ago. Admitted to inpatient rehab unit 4 days ago. History of HTN, DM.
• Examination:
  • Observation: Posterior pelvic tilt, mildly lengthened R trunk, mild R GH subluxation
  • Strength: R UE has isolated joint control; grossly 2/5-2+/5 strength
  • Functional Movement
    • Rolling to R: Mod I; Rolling to L: min A, forgets R UE, extends L LE and head, highly effortful
    • Self-feeding: Able to initiate grasp of utensil, but unable to bring to mouth against gravity
    • Anterior Reaching: Increased posterior pelvic tilt, excessive R scapular elevation, Left side bend, upper trunk/neck extension. Initiates with scapular elevation, limited wrist extension
    • Sitting balance: Static good, dynamic poor –needs to maintain UE support on bed. Maintains weight shifted to L.
What are possible interventions?

Interventions

Movement Deviations
- Difficulty rolling with poor upper/lower trunk flexor coordination
  - Use of extensor strategy
  - Forgets R UE
- Poor Lower Trunk Stability
  - Increased posterior tilt with reaching
- Impaired strength and timing for reaching
  - Excessive thoracic extension
  - Early scapular elevation

PNF Interventions
- Mass Flexion, R UE Extension-Adduction-IR, Scapular Ant-Dep, R Pelvic Ant-Elev
- Mass Flexion, R/L Pelvic Ant-Elev, Hooklying stabilizing reversals
- R Scapular Post-Dep (eccentric), R UE Flexion-Abduction-ER, Seated stabilizing reversals
Summary

Movement analysis is starting place for use of any interventions technique
Comparison of static posture when compared against movement will often highlight areas of need
Improved function with improved trunk control
PNF can be used to address multi-joint coordination, increase trunk activation, and provide more efficient concept of movement
PNF Philosophy

1. Everyone has potential
2. An integrated approach that addresses whole person
3. A positive approach that focuses on what the patient/client **CAN** do
4. Interventions must be toward a specific functional goal
5. Incorporates the use of stronger body parts to strengthen weaker ones
6. Facilitate a maximal response
7. Use repetition to promote motor learning
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PNF Basic Principles

1. Patient Position
2. Manual Contacts (Lumbrical Grip)
3. Therapist Position/Body Mechanics
4. Appropriate “resistance”
5. Traction and Approximation
6. Quick Stretch
7. Irradiation
8. Normal Timing
9. Patterns of Facilitation
10. Visual Input
11. Verbal Input
Using the Patterns and Techniques

Patterns can be done in isolation or in combination with movements
- Ex: UE Ext-Add-IR with rolling

Patterns can be done in multiple positions
- Ex: UE Flex-Abd-ER in supine vs seated
- Ex: LE Ext-Abd-IR in supine vs sidelying

Use PNF techniques to teach, modify, increase demand, or emphasize a functional activity
- Ex: Rhythmic initiation or replication to teach a movement or pattern
- Ex: Dynamic reversals for Pelvic Ant-Elev and Post-Dep to mimic gait cycle

Typical Trunk Responses
- UE Extension -> Trunk Flexion
- UE Flexion -> Trunk Extension
- LE Extension -> Trunk extension
- LE Flexion -> Trunk flexion
- Scapular Elevation -> Trunk Lengthening
- Scapular Depression -> Trunk Shortening
- Pelvic Elevation -> Ipsilateral Shortening; Contralateral Elongation
- Pelvic depression -> Ipsilateral Elongation; Contralateral Shortening
What can you do with PNF?

Analyze and improve the efficiency and effectiveness of human movement and function

Thank you!
Questions?

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References

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