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# PNF Loaded Movement Training for Aquatic Therapy

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## Learner Objectives

The participant will be able to

- Describe at least three evidenced based benefits of loaded movement training (LMT).
- Identify all four PNF patterns and the different lines of stress in LMT.
- Identify the differences between buoyant, drag and weighted equipment.
- Identify patient diagnoses to benefit from PNF LMT in the pool
- Describe at least three ways the use of weighted equipment with LMT builds stability and mobility in the aquatic environment.

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## PNF Loaded Movement Training for Aquatic Therapy

An emerging trend known as Loaded Movement Training (LMT) is an effective training program which includes integration of physiological systems, lower compressive forces on the joints and skeletal structures of the body and multidirectional stability, mobility, strength and power. Taking the LMT concepts to the pool uses PNF patterns and buoyant and drag equipment to challenge and condition muscles and fascia and other systems of the body

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## Outcomes

| Describe | Review | Differentiate | Identify |
|---|---|---|---|
| Describe the history of LMT and evidenced based benefits | Review 4 PNF patterns and the different lines of stress on LMT | Differentiate between buoyant, drag and weighted equipment and it's effect with LMT to build stability and mobility in the aquatic environment | Identify patient diagnoses to benefit from PNF LMT in the pool |

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## History

- The Loaded Movement Training originator and his colleagues developed strength and fitness programs for hockey athletes
- Farm kids had advantages. Fast on the puck, stronger in front of the net when battling their opponents, and stronger and more agile in odd body positions
- Differences so pronounced that they scrutinized what the farm kids were doing

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## Farm Chores

- The farm kids had no fitness training, but did chores every day
- After analyzing farm chores, LMT technique was created

## Loaded Movement Training

LMT is consistently combining an external load with specific, task-oriented motions to strengthen the body in ways that do not happen with standard weight training or body exercises. (this is what the creators of LMT saw with “chores”)

The Trainers changed the training program and got great results from all their athletes.

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## LMT Changed Weight Lifting 1

- Conventional strength training exercises most often use a cam or pulley to control the path of motion of the weight, or free weights such as barbells or dumbbells
- Weight machines are designed to place the greatest amount of resistance at the point which a specific muscle is capable of producing the highest magnitude of force during a concentric (shortening) muscle action.
- Traditional free weight exercises feature curvilinear joint actions, which typically take place in a single plane of motion, where muscles work to generate force directly against the downward pull of gravity.

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## Single Plane is how we normally train

- Note the lines of stress in a shoulder press up/triceps extension.
- These localized moves, up and down lines of focus in the shoulders, create hypertropic effects in the muscle.

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## Weight Lifting

1

This training with moderate to heavy loads for a limited number of repetitions has been the accepted method for improving muscle size and definition

- (Hypertrophy)

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Recent research, however, indicates that using lighter loads while moving in a variety of directions at different velocities may be the most effective method for developing integrated strength throughout the entire mysofascial network.

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## Weight Lifting: 3

Muscles control two different types of forces moving through the body:

- compressive forces, which create muscle shortening
- The balance between these two forces means that as muscle tissue on one side of a joint is shortening, the tissue on the opposing side experiences tension and strain as it is lengthened. It is the lengthening of the elastic fascia and connective tissue as a result of tensile forces that is responsible for producing the mechanical energy necessary for movement.
- tensile or strain forces, which result in muscle lengthening

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Loaded Movement Training w/free weights

Note the lines of stress in loaded movement. Variable lines of stress distribute stress to the entire body and create tissue remodeling over the entire body.

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## LMT Concepts

- The LMT originators decided there were two basic precepts:

#1 Multiple Joint

- The stimulus of different lines of stress offers variability to build strong, stable bodies that are mobile and resilient
- Integrating multiple joint motions:
  - Moves stress away from specific areas in the body
  - Introduces stress to the whole system as it shares the load
  - Lifting and other training has to be multiple joint

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## Task Oriented is Multiple Joint

- Task oriented, full body motion patterns happen when the entire body is used to move from one point to another:
  - working in the garden
  - loading a dishwasher
  - taking a child out of a carseat
  - playing a sport
  - ADLs

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## LMT Concept 2: Loading

- Moving with varying external loads – lines of stress that trigger the remolding of tissue. Most training moves external mass along linear patterns
- This stimulus is incomplete
- Loading on linear paths is not as effective
- Loading with multiple joints is best

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## LMT Concept 2: Loading

- Multiple, variable lines of stress
  - Throwing hay bales versus a repeated set of bicep curls
  - LMT challenges and conditions muscle, fascia, the nervous system, skin and other systems of the body (Hinz 2013, Leonard 1998, Shanahan 2009, Siff 2003)
  - The intention is not to replace current training methods with LMT, but rather to add LMT into a training protocol
  - External loading with multiple joint is the best

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## LMT affects the whole myofascial net

- Headache
- "Crick" in your neck
- "Ache" in your back
- "Stiffness" in your hips and knees
- "Discomfort" in your feet

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## Land Based Example

- Parents pick up their kids off of the ground
  - THEY DON'T
    - Take the time to set their feet in a neutral position
    - Position their perfectly still child in a symmetrical position relative to his or her midline
    - Brace and symmetrically load each arm as they pull the child up
- There's no cognitive thought relative to their body position. They simply hold onto the child however they can, and lift him/her to whatever position is manageable at the time.

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## Pick Up Your Bag (or Bike)

- The only constant in human movement is continuous variability
- Do we teach this?
- We need to teach our patients how to protect themselves during this movement
  - Stabilization
  - flexibility

## Another Land Based Example

- The barbell squat requires an individual to set his or her feet in parallel and maintain spinal extension and a symmetrical alignment in the hips, while lowering and raising the barbell against gravity.
- Compare that to a woman spending the day working in her garden. As she's digging in the dirt, she will be performing a variety of different squats with her feet and hips in a variety of different positions.
- Symmetrical squats won't adequately develop the ability to use fascia to produce and mitigate forces across the entire network, which is what actually happens while going about with life.
- We need to teach how to get off the ground

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## Multiple Joint/Variable Loading

Lawn Bowling is

- Multiple Joint
- Variable Loading

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## Multiple Joint/Variable Load

Prone Plank:

- Multiple Joint
- Variable Load

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## Variable Load

LMT can be used to apply constant variability by manipulating

- The direction
- The distance
- The speed of an exercise

MIX IT UP! There are no rules!

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## What LMT is to Me

- After studying LMT research and articles, I believe LMT combines two concepts that we are already familiar with:
  - PNF – Proprioceptive Neuromuscular Facilitation
  - Asymmetrical Loading
- So, let's review some PNF

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## PNF D1 Flexion Pattern

- **PNF D1 flexion** for the upper and lower extremities includes:
- **External rotation**. Other elements of motion associated with external rotation are:
- **Supination**--turning the palm of the hand up or rotating the foot's plantar surface inward into dorsiflexion.
- **Radial flexion**--angling the hand toward the thumb side or
- **Inversion**--turning the foot inward toward the big toe side.
- **Adduction**--movement across the midline to the side opposite the extremity.
- **Flexion –** movement that decreases the angle of a joint.

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## PNF D1 Extension Pattern

- **PNF D1 extension** for the upper and lower extremities includes:
- **Internal rotation**. Other elements of motion associated with internal rotation are:
- **Pronation**--turning the palm of the hand down or rotating the foot's plantar surface outward into plantarflexion.
- **Ulnar flexion**--angling the hand toward the little finger side or
- **Eversion**--angling the foot toward the little toe side.
- **Abduction**--movement away from midline and to the same side.
- **Extension –** movement that increases the angle of a joint(s).

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## Differences between D2 Flexion and Extension for UEs and LEs

- **When doing the flexion portion of PNF D2 with the upper extremities, there is abduction and external rotation.**
- **When doing the flexion portion of PNF D2 with the lower extremities, there is abduction and internal rotation.**
- **When doing the extension portion of PNF D2 with the upper extremities, there is adduction and internal rotation.**
- **When doing the extension portion of PNF D2 with the lower extremities, there is adduction and external rotation.**

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## Tips

- **PNF D1 flexion begins with the upper extremity/hand or lower extremity/foot on the same side and ends with them on the opposite side.**
- **PNF D1 extension begins with the upper extremity/hand or lower extremity/foot on the opposite side and ends with them on the same side.**
- **PNF D2 flexion begins with the upper extremity/hand or lower extremity/foot (in a standing position the lower extremity /foot are positioned behind the other lower extremity) on the opposite side and ends up with them on the same side.**
- **PNF D2 Extension begins with the upper extremity on the same side, and ends on the opposite side.**

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## Positioning for UE D1 Flexion

- The starting position is with the right upper extremity turned in at the shoulder (internal rotation),
- positioned behind the shoulder (extension),
- and slightly out to the right (abduction).
- The forearm is turned in (pronation),
- the hand is pulled out towards the ulnar side (ulnar flexion), and
- the fingers are spread apart.

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## Performing UE D1 Flexion

- Close the hand into a fist (flexion),
- pull it toward the radial side (radial flexion),
- and move the hand forward on the wrist (flexion),
- while turning the palm in toward the right side (forearm supination).
- Simultaneously, turn the upper extremity out at the shoulder (external rotation),
- bend the elbow (flexion),
- and move the upper extremity up (flexion) and over (adduction) to the opposite side as though to touch the left ear with the right hand.
- Throughout the movement, keep the eyes looking at the hand as the head turns to the left (rotation) and looks up (extension).

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## Performing UE D1 Extension

- Open the right hand (extension)
- and angle it toward the ulnar side (ulnar flexion),
- pulling the hand back on the wrist (extension),
- while turning the palm away from the body(pronation).
- Simultaneously, turn the upper extremity in at the shoulder (internal rotation),
- straighten the elbow (extension).
- Move the upper extremity down and back (extension)
- and out to the right side (abduction).
- Throughout the movement, keep the eyes on the hand as the head turns to the right (rotation) and looks down (flexion).

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## Bilateral UE D1 Pattern

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## Positioning for UE D2 Flexion

- Start with the right upper extremity positioned diagonally across the chest and down and to the right (past midline).
- The right hand is above the right hip.
- The right hand is closed (flexion) and angled toward the ulnar side (ulnar flexion).
- The palm is facing away from the body (forearm pronation).

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## Performing UE D2 flexion

- Open the right hand (extension) and angle it toward the radial side (radial flexion), while turning the palm upward (supination).
- At the same time, turn the upper extremity out from the shoulder (external rotation), and, leading with the thumb, raise it diagonally up (flexion) and out to the right side (abduction).
- Throughout the movement, keep the eyes on the right hand as the head turns to the right (rotation) and looks up (extension).

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## Performing UE D2 Extension

- Close the right hand (flexion) and angle it towards the ulnar side (ulnar flexion),
- while turning the palm outward (pronation).
- At the time, turn in the right upper extremity from the shoulder (internal rotation)
- and lower it diagonally down (extension) and across midline (adduction) to the starting position above the right hip.
- Throughout the movement keep the eyes on the right hand as the head turns to the right (rotation) and looks down (flexion).

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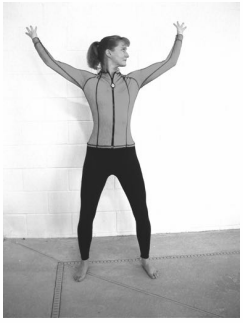

## Bilateral UE D2 Pattern

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## Stand up!

- Let's play with some PNF patterns:
  - R LE D2 extension; L UE D2 extension; R UE D1 extension – balance; bounce
  - L LE D2 flexion; R UE D2 flexion; L UE D2 extension – balance;
  - switch R LE to D2 extension – what happened to the UEs?
  - R LE D1 extension; R UE D2 extension;
  - L UE shoulder flexion to 90 degrees –
    - Balance; hop;
    - switch L LE to D1 extension, L UE D2 extension, R UE 90 degrees shoulder flexion;
    - bring extended LE off the floor; hop; switch again

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## PNF with Asymmetrical Loading

- Which patterns do you see in the top photo?
- L UE PNF D2 flexion
- R UE PNF D1 flexion

- Which PNF patterns do you see in the bottom photo?

R UE PNF D1 extension

L UE PNF D2 extension

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## Absolutes

- Move in pain free ROM
- Remember THR precautions
- Use progressive overload (# reps, props)
- STOP with fatigue
- Emphasize proper posture and neutral pelvis
- Begin with a warm up

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## Now, let's review asymmetrical loading

Whether using a baseball bat, tennis or racquetball racquet, or the catcher squatting at home plate reaching for a ball outside the plate, these are asymmetrical loaded moves.

Repetition of sports patterns and asymmetrical loading are included in sports training.

What other sports can you think of?

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## Applying LMT to Athletes

The trend is training athletes in “functional” movement patterns specific to the demands of their sport

Regardless of what “function”, they will not perform exactly the same movements exactly the same way in every practice or competitive situation

During competition, athletes have to constantly adapt their body movements to the locations of both their teammates and opponents

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## LMT for Athletes

- The highest level performers actually demonstrate a wide variance in movement patterns when executing a play
- Loaded movement training allows athletes to develop sport specific strength by using variable, high velocity movements corresponding to game like situations
- This helps them to have a greater carryover effect from the conditioning room to the competition arena

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## Variable Asymmetrical Loading

- Research indicates that high performing athletes depend on constant movement variability to achieve success
- Time-motion analysis studies indicate that even at the highest levels of performance, athletes do not perform successive movements exactly the same way
- Hamill, Palmer and Van Emmerik, 2012:Barlett, What and Robins, 2007

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## Variable Squat Benefits

Conditioning the soft tissues to handle unique directional forces and joint positions is paramount for an athlete like this hockey goalie.

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## Coaching Points for Variable Squats

| Initial Learning | First Progression | Final Progression |
|---|---|---|
| Slow, controlled | Rhythmic real life speed | Moving w/increased speed or load |
| Minimal to no weight | Light to medium weight | Tweaking foot position or handprint |
| Small to medium ROM | Greater ROM | Exploring End Range |

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## Traditional vs. Variable Squats

| TRADITIONAL | VARIABLE |
|---|---|
| SAGITTAL PLANE DOMINANT | MULTIPLANES |
| FIXED FOOT POSITIONS | MULTIPOSITIONAL |
| MUSCLE FOCUS | MOVEMENT FOCUS |
| SLOW | VARIABLE SPEEDS |
| MAX TO NEAR MAX (75% +) LOAD | SUBMAXIMAL LOAD (75% -) |
| SMALL FREEDOM OF MOTION | LARGE FREEDOM OF MOTION |

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## Variable Squats

- Submaximal squats designed to enhance the body's ability to handle three dimensional force across various speeds, masses, directions and ranges of motion.
- This is LMT, and it's what people do – so it's what we need to teach them to do safely.

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## Sit to Stand

Variable squat using arms of chair

Variable squat using arm of w/c and crutch

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## SQUAT PIVOT

Skateboarding
- variable foot positions
- variable squat positions
- variable planes
- variable loads

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## Our Athletes

The athletic/sport skill for some of our clients is:
- Reach
- Stand
- bend

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## Reach - supported, unsupported, cross body

Supported – feet on the ground

Unsupported- jumping up off the ground

Cross Body – reach and make the basket!

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## Bend – squat, lean

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## Water

- Why water?
  - Regression
  - Allows body to move more freely
  - Less pain
  - Variable forces

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## PNF in the Aquatic Environment

- Maximizing use of Buoyancy & Resistance
  - Buoyancy
    - Reduced guarding and compensatory patterns
    - Modified PNF D1 and D2 during ambulation is an effective method to improve trunk stabilization and to increase LE muscle tone
- Resistance
  - Accommodating in all planes of motion
  - Altered by speed of movement and surface area of moving extremity and/or drag equipment

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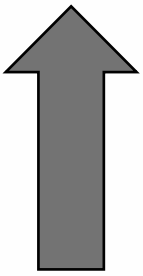
## Upper Body Equipment

Buoyancy assisted =
Toward the top
of the pool
= eccentric



Buoyancy resisted =
Toward the bottom
of the pool
= concentric

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## Buoyant handbar for UE

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## Buoyant Cuff for LE

A buoyant cuff on the LE will require strong core stability to keep the cuff from floating up during PNF in the Pool.

A strong core and good balance is required to prevent low back hyperextension when extending the LE during PNF in the Pool

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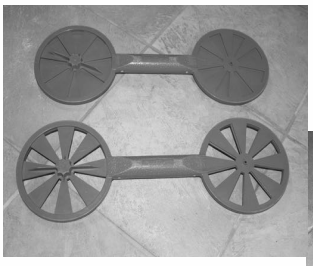
## Surface area equipment
## Gloves, Flexpaddles and Aquafins



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## Drag Resistance for LE or UE

A drag resistance fin on the LE will increase the surface area in the water to increase the intensity of moves in all directions.

A strong core is required if proper pelvis alignment is to be maintained.

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## #1

- PNF in the Pool DVD
- PNF in the Pool Manual

- LMT is all PNF patterns
- PNF is the original and natural multiplanar exercise plan


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## #2

- Add Asymmetrical Loading: resistance, weighted or buoyant
- Use equipment on only one leg or one arm OR, use different loads on each side

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## Rehab Link

- LMT can be a missing link in rehab and conditioning
- Our bodies evolved to move with loads
- Perhaps we should include more LMT and PNF in our rehab programming

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## Water Application

Bilateral UE PNF D2 pattern with asymmetrical loads (resistance, weighted or buoyancy. Vertical position.

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## PNF in the Pool

- Unilateral LE PNF D2 flexion with asymmetrical load

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## LMT PNF in the Pool

Rotate hips as you pivot right with a PNF UE D2 pattern with an asymmetrical load

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## LMT PNF in the Pool

Reach L with both UEs while walking forward with the head turned L, then R

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Bilateral UE PNF Patterns

with asymmetrical loads – resistance,

weighted or

buoyant

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What do we have here?

Top photo:

R UE PNF D1 extension with drag equipment

R LE PNF D1 flexion with buoyant equipment

Bottom photo:

R UE PNF D2 extension with buoyant equipment

L LE PNF D1 flexion with drag equipment

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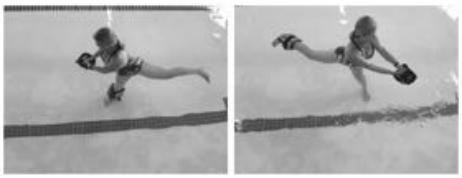
## Asymmetrical Loading and Asymmetrical PNF



Challenge your patients with a buoyant cuff to stabilize core and balance

Challenge your patients with drag equipment to strengthen core

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## #3 - Progress

- Move the load
- Change the beginning position of the exercise to the end position
- Stop partway through the move
- Change directions
- Change depth of water
- Change speed of movement

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## LMT, PNF. Which pattern? Loaded where?



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## Seated Bilateral Asymmetrical Lower Extremity PNF

The R LE is PNF D1 extension and the L LE is PNF D1 flexion

The R LE is PNF D1 flexion and the L LE is PNF D2 flexion

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## Which PNF Patterns?

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## Aquatic Sports Training Example

Tennis Example

Equipment: buoyant cuff on dominant forearm and ankle

Parachute strapped to non dominant leg

Exercises:

- jog R diagonal
- hop straight back on R foot while L foot swings diagonally with dominant arm overhead
- Crossing jog to L while reaching both arms across body ready for backhand
- Backhand swing (both arms) forward while stopping and stabilizing on dominant leg only

- Think of other golf swings, baseball, basketball, soccer applications that work for you and your clients

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Functional Patterns. Which ones?

Top photo

L UE PNF D2 extension

Bottom photo

R UE PNF D2 extension

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Let's look at some videos now:

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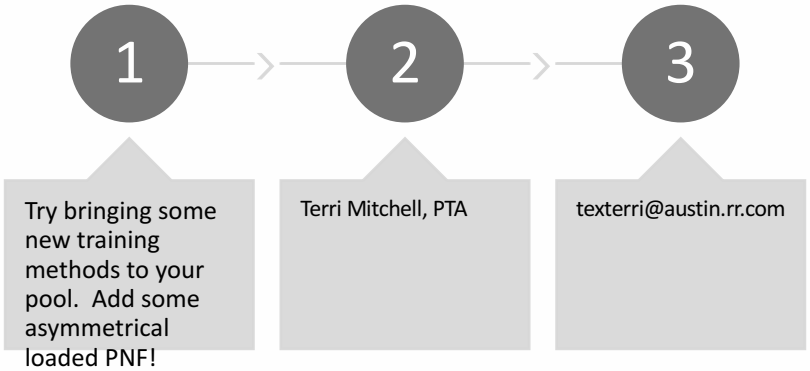
# THANK YOU!


1
2
3
Try bringing some new training methods to your pool. Add some asymmetrical loaded PNF!
Terri Mitchell, PTA
texterri@austin.rr.com

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