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Physical Therapy Applications for Individuals with Neurologic Dysfunction

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Physical Therapy Applications for Individuals with Neurologic Dysfunction

Dr. Charlotte Chatto. PT, PhD

CHAPTER 1

Key assessment and Interventions: Focus on Patients with Guillain Barre and Spinal Cord Injury

In this chapter, the primary physical therapy examination techniques for patients with neurologic dysfunction will be described and demonstrated. Although many of these techniques are equally appropriate for patients with other diagnoses, such as medical or orthopaedic conditions, the focus will be on possible outcomes when a person's nervous system has been damaged by injury or disease.

Strength, Reflexes, and Flexibility

Key Points

1. In persons with damaged nervous systems, these tests may be context-dependent.
2. It is important to test and re-test in the same environment and in test positions.
3. Recognize that the results of these tests may not automatically translate into what you might predict a patient's performance will be during a functional activity.

General considerations

Safety

Although the therapist is assessing the musculoskeletal system, in a patient with neurologic dysfunction, cognitive issues resulting in a decreased awareness of overall safety must be considered. In addition, in the presence of weakness or sensory loss, body alignment and joint protection is often one of the therapist's most important tasks. Providing external stability through manual contacts and support from the sitting surface will not only protect the patient, but also allow for the most reliable results of the tests.

Posture and Positioning

Posture and alignment of body segments, must not be overlooked in the individual with neurologic dysfunction. In order to function effectively and efficiently, the human body must be able to respond to changes in gravity secondary to alterations in the alignment of body segments.

The therapist needs to consider:

- Both movement and the relationship between how the muscles are functioning and the patient's biomechanical alignment.
- The initial postural alignment of the patient before movement.
- The alignment of body segments throughout the movement.

Motor Control

The control of a patient's movement is often more critical to consider than his or her ability to produce force. For example, in a patient with a

cerebellar lesion, strength will be typically be intact, however functional activities that involve the coordination of this strength may have significant deficits.

The therapist needs to consider:

- The muscles used to complete the desired movement.
- The patient's ability to relax antagonists allowing the agonists to contract effectively.
- The velocity and acceleration of movements desired to efficiently complete the task
- Compensations in other body segments

Range of motion

Use care when performing of joint range of motion (ROM) tests and activities in the presence of spasticity or flaccidity. Spasticity may interfere with range measurement because it may change depending on the relationship of the trunk or extremity to gravity, therapists' hand positions and technique.

Instructions to the patient: Make sure that your commands to the patient are consistent with the type of ROM you are assessing (or performing as a treatment intervention). Some examples of instructions follow:

- **Passive:** "Relax and let me move you."
- **Active Assisted:** "I want you to try to move through the motion and I will help you if you need assistance." When you ask the person to try to move, but there is no movement noted, this will still be considered active-assisted not passive, because of the commands given. Documentation should reflect this distinct difference. For example, a therapist may document: "Active Assisted ROM was attempted, but no motion noted."
- **Active:** "I want to you to move through the motion as far as you can."
- **Hand placement:** The technique used while performing ROM may promote hyperactivity in the muscle being elongated. Examples include: During ROM at the ankle, a hand on the ball of the foot may produce hyperactivity in the gastrocnemius-soleus and prevent full movement into dorsiflexion; during wrist extension, palmar contact may promote finger and wrist flexion limiting elongation of the long finger flexors.
- **Speed of technique:** The speed of the technique may produce spasticity -- the faster the movement the more likely the muscles are to respond with involuntary contraction (see tone below)
- Protecting the joints: In the presence of flaccidity care must be taken, as the joints have no protection from the normal reaction of muscles to stretch. Overstretching of joint structures may occur. The shoulder is particular vulnerable. Remember to always have one hand on the scapula when performing ROM.

Flexibility

Individuals with neurologic impairment generally demonstrate deficits in voluntary movement, whether secondary to muscle weakness/imbalance, spasticity, or posturing. Alterations in muscle tone secondary to neurologic insult may lead to changes in the muscle properties itself. These changes in the architecture of

the muscle cause a reduction in the flexibility of the muscle, or the ability of the muscle to lengthen appropriately.

As with testing joint ROM or flexibility in a person with a neurologic injury, remember to move the limb slowly to avoid eliciting spasticity that may reduce accuracy of your tests. The following body parts/segments that are important to assess are listed below, each with a particular critical aspect of functioning that requires that particular flexibility.

- Cervical flexibility in all planes of movement for head righting and equilibrium reactions
- Pectoral muscle length for posture and balance
- External rotators of shoulders and supination of forearms for upper extremity support in the absence of triceps
- Wrist extensors for upper extremity support
- Trunk elongation for general posture, balance, and mobility
- Hip lexors for prone assumption and gait
- Hamstring length for upright activities and gait
- Hip adductor length for ADLs and hygiene, as well as general mobility
- Hip external rotation with hip flexion for dressing
- Hip internal rotators for scooting and gait
- Plantarflexor length for gait and balance reactions

Reflexes

Examination of the deep tendon reflex (DTR) is an unconscious motor response to a sensory stimulus. It gives information about the location of the neurologic lesion by assessment of the reflex arc. Performance of this test requires a reflex hammer to provide stimulation of sensory receptors (the muscle spindle), which evokes action potentials that are conducted into spinal cord. The sensory neuron synapses with an association neuron, which synapses with somatic motor neuron, which conducts impulses to muscle and stimulates a reflex contraction. Remember that the brain is not directly involved.

Interactive 1.1 Complete the chart in preparation for practicing MMT skills

Self Directed Lab Activity 1.1

For each of the muscles and activities listed above, role play as if you lack significant flexibility and then try to perform the associated activity to experience the difficulty in movement

- Hyperactive tendon responses suggest lesions of the UMN, (corticospinal tracts).
- Pendular tendon relexes are suggestive of cerebellar (Cb) dysfunction.
- Absent tendon relexes suggest LMN lesions. (Compare with decreased responses in an orthopedic evaluation.)

Examination may include any or all of the following reflexes, each representing a particular myotome, which is the group of muscles a specific nerve root(s): (There are videos for reflex testing and other testing on **www.neuroexam.com**.. .it is open access, but you cannot download the videos. We could insert the link for now and maybe we take our own later)

- Achilles tendon (S1,S2)
- Biceps (C5, C6)
- Brachioradialis (C6)
- Quadriceps (L3, L4)
- Triceps (C7)

Strength

Manual muscle tests (MMT) are used to evaluate strength and can be misleading in the neurologically impaired individual. These individuals certainly have weakness, but it is a more complex phenomenon than weakness that results from the patients with intact nervous systems. Lesions of the upper motor neuron affect the number, type and discharge frequency of motor units recruited during performance. Even if there is minimal or no loss of cross-sectional area in the muscle fibers, force generation is impaired. Over time, secondary changes can also occur in muscle with selective atrophy of fast twitch fibers.

- The nervous system adopts a variety of synergistic muscle activation patterns to control the body's degrees of freedom, or available planes of movement. A neurologically impaired person often has less control and fewer synergistic patterns are available. This makes it difficult for an individual to isolate a muscle or muscle group for a reliable manual muscle test. The opposite also holds true that individuals unable to isolate a muscle contraction as required for a muscle strength test, might exhibit good force production in a gross or mass synergy pattern.
- Results of strength testing on a person with an upper motor neuron lesion cannot be reliably interpreted without knowing details of the testing procedure. Even then, the test results may not tell you what the person is capable of doing functionally.
- The muscle itself may be capable of producing force, but the strength may test lower secondary to recruitment problems, problems of co-contraction, timing of contractions or sequence of firing of muscles involved in the motor plan

- An individual might produce a grade 0 or 1 on an isolated movement test but perform at a 3/5 or better on a task where it acts synergistically with others. This is an example of strength or force production being task specific.
- This weakness might not be improved by specific exercises to strengthen the muscle.

Clinical Tips:

- As a rule of thumb, muscle testing is only valuable if the patient is able to produce an isolated muscle contraction.
- Documentation for motor ability, if MMT grades are not appropriate, should qualitatively describe the percentage or fraction of movement throughout the range of motion being tested.

Functional Mobility Training for Patients with Spinal Cord Injury

Key Points

- For as long as needed for preventing orthostatic hypotension, make sure the patient has the following donned, before moving to an upright position:
  - Thigh-high compression stockings, such as TED ™ hose
  - Elastic wraps, such as ACE ™ wraps over the stockings
  - An abdominal binder will assist with blood pressure, but should be used for any patient without full abdominal innervation to assist with the length-tension relationship of the diaphragm. This will allow the patient to take a deeper breath.
- If you are planning to help the patient transfer to a chair, make sure you have a wheelchair with appropriate amount of support (for example, head support for a patient with high tetraplegia) and a pressure distributing cushion.
- For a patient who does not have full innervation of his hand, make sure you protect your patient's tenodesis by never allowing wrist extension and finger extension
- If the hamstring range of motion (ROM) is not at least 90 degrees, be very careful not to have the patient assume positions in which his knees are extending in long sitting and his back is in a flexed position. This will provide an excessive stretch to the back extensors and compromise the passive stability of the trunk. Once bilateral hamstring (ROM) is at least at 90 degrees, then long sitting can be assumed with extended knees.

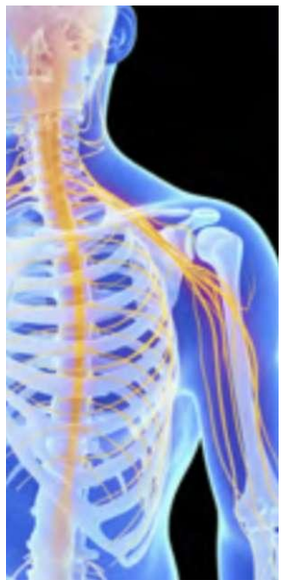
Transfer 1 Therapist Over Patient's Back

Transfer 2 Therapist Under Patient's Arm

Transfer 3 Therapist Using A Stool

Mobility 1 Independent Mat Mobility For Patient With C5 Spinal Cord Injury

Mobility 2 Mobility and Gait With Lower Extremity Orthodics



CHAPTER 2

Respitory Assesment and Interventions

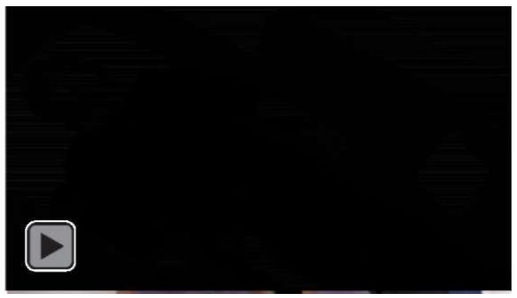
The therapeutic interventions you choose to address recovery of motor function in your patient with neurologic dysfunction all have a theoretical foundation. Key theories will be presented and video demonstrations of interventions will help you begin to fill your toolbox with options to drive neuroplasticity and facilitate your patients' recovery.

Assisted Breathing Techniques

Key Points

1. A thorough auscultation examination will provide a baseline to help determine which techniques to use and to determine effectiveness of the techniques
2. Assisted Breathing and Coughing Techniques can only be performed with patients who have a stable spine and no rib fractures.

Diaphragmatic Breathing (facilitation of the diaphragm):



Diaphragmatic Breathing (facilitation of the diaphragm)

Explain the purpose and goals of the exercise. Position the patient supine with legs flexed at 45 degrees in a relaxed and well supported fashion. Demonstrate and explain the technique. Place hand or hands at the costophrenic angle. Squeeze down and inward gently during exhalation. Allow the patient to breathe into your hand during inspiration. After several respiratory cycles the therapist will ask the patient if he feels a difference and should try to perform the maneuver independently using his own hand. How can you modify this technique for the individual without upper extremity control?

Inhibition of the diaphragm:

- **Supine position:** the heel of the therapist's hand is placed lightly on the patient's abdomen below the base of the xiphoid process. As the patient exhales the therapist gently allows his hand to follow the diaphragm up and in. When the exhalation is complete, the therapist will keep his hand in this position. At the next exhalation the therapist will move his hand further in and after two or three cycles, the therapist keeps his hand in one position and observes the patient. The patient will unconsciously alter his breathing pattern to use accessory muscles. When this has happened, the therapist will explain what has occurred and ask the patient to try to

Inhibition of the diaphragm: Supine Position

reproduce the breathing pattern. The therapist will gradually disengage his hand, observing carefully for the maintenance of the new breathing pattern by the patient. If the patient cannot maintain the pattern, the therapist will help by reapplying the pressure until the patient regains control of the pattern.

- **Prone position:** the patient is positioned prone on elbows. This position will effectively compress the excursion of the diaphragm, forcing the patient to utilize accessory muscles. The patient can then practice the preferred breathing pattern as well as incorporating it into other activities such as head and neck movement, reaching and single arm support. Note... this position is much more threatening to the patient than the supine position and should not be attempted as an early training technique. When is it likely you would desire an inhibition of the diaphragm? When would this technique be indicated?

Inhibition of the diaphragm: Prone Position

Upper chest breathing using the pectorals:

Upper chest breathing using the pectorals

the patient is positioned in supine with arms at their sides. The therapist place the heels of her hands close to the sternum and aligns the fingers along the diagonal to the shoulders. As the patient begins to breathe up and into the therapist's hands the therapist applies a quick manual stretch (down and in toward the sternum) thus facilitating the pectoral muscles and expanding the upper chest.

Counter-rotation assisted breathing:

the patient is placed in a sidelying position. The therapist stands/ kneels behind the patient at a 45 degree angle to the head of the plinth. The cephalic hand is placed along the inferior border of the scapula and caudal hand is placed on the ASIS. As the patient inspires the therapist will assist this movement by pushing the shoulder forward and down while pulling the hip backward and down. At the end of inspiration, the therapist will smoothly and gently move her cephalic hand to the gluteal fossa. As the patient expires the therapist assists this movement by pulling the two hands together. In both assists, the hands move in a counterrotation or wringing fashion. It is important in performing this technique to apply pressure through the palms instead of fingertips and palms, which can be painful to the patient.

Counter-rotation assisted breathing

Glossopharyngeal breathing:

no diaphragm action is required for this. An excellent technique to teach a patient if he or she requires ventilator assist. If a patient knows how to do this, then there would not be a fear of loss of electricity or power. The patient open his mouth widely and

abruptly creates a negative area of pressure which air fills. The patient then closes his lips and "swallows" the air down into the lungs. It looks like a frog gulping air. The patient will report a feeling as though his lungs were about to burst if the technique is being performed correctly. A feeling of nausea and indigestion indicates that air is being sucked into the stomach instead of the lungs. Initial training can be very tiring. In addition to providing an alternative method of breathing if a stimulator or ventilator malfunctions, GPB can also act to (a) increase vital capacity or produce a more effective cough, (b) assist in a longer and stronger phonation, and (c) act as an internal mobilizer for the chest wall. Problems which interfere with a patient's ability to perform this activity include an open nasal passage or glottis that allows the air to escape, incorrect shaping of the mouth, incoordinated backward movement of the tongue and swallowing of air into the stomach.

Assisted Coughing Techniques

Key Points

1. A thorough auscultation examination will provide a baseline to help determine which techniques to use and to determine effectiveness of the techniques
2. Assisted Breathing and Coughing Techniques can only be performed with patients who have a stable spine and no rib fractures.

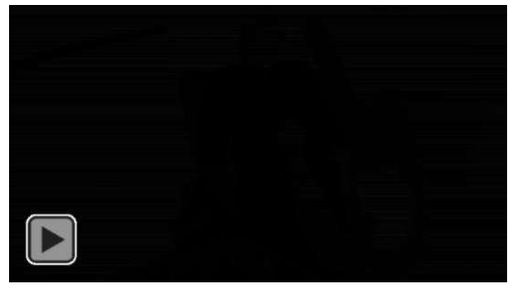
For each of the following techniques, be prepared to discuss the indications, precautions and contraindications.

Techniques done in supine:

Costophrenic assist: at the end of expiration, the therapist gives a quick stretch to the diaphragm and intercostals to facilitate more complete inhalation by compressing the chest at the costophrenic angle toward the central tendon of the diaphragm. This is done several times to fill the lungs. The patient is then instructed to hold the air in the lungs. As the patient gets ready to cough, the therapist performs a diaphragmatic assist by applying a strong pressure up and in toward the central tendon.

Costophrenic Assist

Heimlich-type assist: the therapist places the heel of his or her hand just below the patient's xiphoid process and presses up and in toward the central tendon as the patient coughs. While this is a very effective technique, it is also very uncomfortable for the patient. It may also elicit undesired muscle tone. Thus, it is used only when other techniques are found to be ineffective.



Heimlich-type assist

What are some contraindications for the above coughing activities?

Anterior chest compression: the therapist places one arm across the patient's pectorals and the other parallel to it on the lower abdomen or in the position used in the Heimlich-type assist. After the patient takes a maximal breath, the therapist pushes down to

help the patient cough. The greatest force is applied through the lower chest during expulsion.

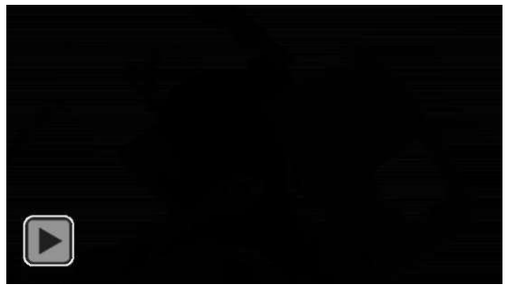
Anterior chest compression

Techniques done in sidelying:

- **Costophrenic assist:** in sidelying, the excursion of the anterior chest wall is now done with gravity-eliminated while lateral excursion becomes anti-gravity In addition, greater balance is required making this a good progression for working on trunk stability for the patient moving from supine to upright This technique is asymmetrical Which segment of the lung is this technique effective for?

Costophrenic Assist

- **Heimlich-type assist:** this is the same as previously described. The only variation involves positioning the patient with both hips and knees flexed. In this reflex inhibiting posture, the chances of eliciting high muscle tone are diminished.



Combined costophrenic and Heimlich-type assist

- **Combined costophrenic and Heimlich-type assist:** the therapist uses both hands at the same time, one to provide a costophrenic assist to lateral excursion and one to provide a Heimlich assist to anterior excursion. Because two planes of respiration are used to remove excretions this method is more effective than either one used alone.

- **Massery counter-rotation assist:** the therapist provides a quick stretch facilitation to the pectorals and the hip hikers at the end of expiration to maximize the next few inhalations. The therapist then facilitates inspiration by stretching along the inferior border of the scapula in an oblique and upward manner while pulling the hip in a downward and posterior fashion. After several breaths have been taken to fill the lungs as much as possible. The therapist positions her hands as she would for the quick stretch but compresses on exhalation. The patient's chest is squeezed in all three planes of respiration making this a very effective method of assistive cough. It is important to follow a true diagonal in both the physical assistance and the compression of the chest so that air is forced out of the lungs. This method has an additional advantage because the rotation component will act to inhibit the development of abnormal muscle tone. Finally, because it does not require active participation on the part of the patient, this technique can be used with incoherent or unresponsive patients.

Massery counter-rotation assist

Techniques done in prone:

Head Flexion assist: the patient is positioned prone on his or her elbows. The patient then extend his head and neck up and back as far as possible, while taking a deep breath. Then, the patient is instructed to cough out as hard as possible while throwing his head forward and down. Because the diaphragm is inhibited in this position this cough will be a fairly weak one and thus should not be the only method of assisted coughing utilized.

Techniques done in sitting:

- **Quad long sitting assist:** the patient sits in a long sitting position with UE support. The therapist instructs the patient to breathe in as deeply as possible while extending neck and upper back fully onto his or her arms. The patient is to cough out forcefully while throwing his entire upper body into a flexed position. A pillow on his legs will prevent injury while falling forward onto his legs.

- **Para long sitting assist:** the technique is the same as described above only more vigorous because of the action of the innervated trunk musculature of the individual with paraplegia

- **Short-sitting self-assist:** The patient is positioned in a short-sitting posture. Both hands are held in the lap with one hand over the other at the wrist. The patient will extend his trunk while inhaling deeply. As the patient coughs, both hands are moving up to the abdomen, compressing the diaphragm in a Heimlich-type maneuver. Most patients can learn to use this technique independently although individuals with tetraplegia will need trunk support to prevent them from falling too far forward.

Technique done in hands-and-knees:

The patient is positioned in an all-fours position. He is instructed to rock forward into a fully extended position while inhaling deeply and then to cough out while moving forcefully back onto his heels with a flexed head posture.

Think about what deficits predispose each of the patients in the cases to respiratory complications. Which of the preceding techniques, if any, would be appropriate for each of them? Be prepared to state your rationale for your choices. What will your evaluation and treatment consist of during the early stages of care?

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CHAPTER 1

Proprioceptive Neuromuscular Facilitation

The therapeutic interventions you choose to address recovery of motor function in your patient with neurologic dysfunction all have a theoretical foundation. Key theories will be presented and video demonstrations of interventions will help you begin to fill your toolbox with options to drive neuroplasticity and facilitate your patients' recovery.

Proprioceptive Neuromuscular Facilitation

Although there has been a paradigm shift in recent years, from a historical perspective, it is important to understand that PNF and NDT both developed from a philosophical belief that in order to recover from a neurological injury, no matter what age you were, you must go through stages of control/development. These treatment techniques are based on a reflexive and neurofacilitation rehabilitation model, making accurate hand placement and manual techniques critical. Current research indicates that the most important way to improve function in persons following neurological injury is to train function. However, this does not mean that strengthening or increasing PROM, with a technique such as PNF, is not indicated. What can be inferred from the literature is that by itself, a PNF pattern is not likely going to improve a functional activity such as reaching. The task of reaching must be trained within a variety of contexts. So, if you are using a neurofacilitation technique, always remember to follow-up with training the task. Performance of the relevant task, without the need for manual facilitation, is the ultimate goal.

The defining elements of PNF include diagonal patterns of movement, combined with specific hand contacts providing facilitation to the muscle spindle. This is required, in order to encourage its reflexive activation of the muscle. The patient is also encouraged to recruit muscles voluntarily to complete a pattern. If the facilitation is removed or delivered incorrectly, the outcome of the desired movement may be affected.

Body Position

The therapist's body position is as important a component as the patient's. Both are essential to the facilitation of the desired response in the patient.

Therapist: The therapist should be positioned at either end of the diagonal, with the mid-sagittal plane of the therapist parallel to the line of movement desired (the therapist belt buckle will

face the motion). The choice of which end is based on: best direction of force reception, the amount of space, best position for visual input, or the individual therapist's preference. The therapist needs to resist each pattern in a line parallel to her or his mid-sagittal plane. MOVEMENT SHOULD ALWAYS BE DIRECTLY INTO OR OUT OF THE CENTER OF GRAVITY OF THE THERAPIST. With the upper extremity patterns, it is often easier to position the therapist at the shoulder and go through a 180o pivot as the motion passes the mid-point of its' arc. It is still important to get the therapists' mid-sagittal plane facing the motion at the beginning and end of the motion.

Patient: The patient should position themselves with body parts in the most comfortable position and with all parts in as close to proper alignment as possible for normal physiological movement. Support the normal curves of the body, e.g.. lumbar lordosis in supine, cervical spine in side lying, waist in side lying. For extremity patterns done in supine, it works better to get the patient as close to the edge of the support surface and is safe.

Body Mechanics

The movement of the therapist directly influences the response of the patient and should enable the patient to move correctly and freely in the diagonal. Key points to remember:

- The therapist's spine is most stable in neutral rotation and lateral flexion: AVOID ROTATION OR LATERAL FLEXION OF THE SPINE DURING PNF!
- The majority of the movement should come from the legs and hips
- The therapist should always move or shift weight in the direction of movement desired from the patient
- Arms and hands should stay relaxed, and the majority of the resistance should come from the therapist's trunk and pelvis
- The therapist's center of gravity stays even with the arc of movement of the patient; if the center of gravity of the therapist becomes lower than the movement of the patient, there is more therapist work due to increase in patient's mechanical advantage.

Clinical Tips

- Manual contacts may vary between individuals. The best contact is that which facilitates the correct response in the desired direction.
- Remember, gravity alone may be enough resistance to facilitate the desired response.

Manual Contacts:

"Appropriate" hand placement is essential to facilitate the desired response in the patient. Manual contacts LEAD the desired motion and must oppose the desired motion. Manual contacts need be specific and follow one of two rules. The contact surface needs to be the most precise and direct surface to resist the desired motion or it needs to contact the specific

agonist muscle, or muscle group in order to facilitate that muscle and be on a surface that resists the desired motion. The role of the manual contact is to increase the stimulation of the skin and other receptors to enhance the desired motor response.

Lumbrical Grip: This manual contact utilizes the intrinsic muscles of the hand, allowing for a comfortable, specific, and secure contact. The key contact points are the palm of the hand, specifically the thenar and hypothenar eminences, the entire palmar surface of the fingers, and the FINGER PADS, not the tips! REMEMBER: Point pressure produces PAIN & WILL INHIBIT THE DESIRED RESPONSE!

Quick Stretch: Immediately prior to commands for muscle contractions, a quick stretch of the agonist muscle enhances the agonistic muscle contraction. The therapist does the quick stretch at the end of the lengthened range of the agonist. The therapist applies the stretch to as many of the agonistic muscles in the given pattern as practical. This quick stretch is intended to trigger a reflex muscle contraction that coincides with the initiation of the client's voluntary contraction. The therapist times the quick stretch with the client's contraction by giving a verbal cue ["and....pull (or push)"] in which the quick stretch immediately precedes the "pull" or "push" commands the voluntary contraction. The therapist fine-tunes the client's response by adjusting the delay between the quick stretch and the "pull" or "push".

Appropriate Resistance:

The amount of resistance should allow for smooth, coordinated, and appropriate speed of contraction throughout the available range of motion. Over-resisting leads to halting or too slow motion. The amount of resistance will vary through the range to facilitate smooth flow of the desired response. Resistance will be greater where the patient has most strength and mechanical advantage and less where the motion is weaker.

Use resistance for any of the following:

- strengthening
- increasing range of motion
- increasing stabilization
- enhancing relaxation
- enabling appropriate speed of contraction
- increasing coordination

Isotonic: concentric, eccentric, maintained; the command and intent is always for movement though at times little movement may occur (commands are "push!" or "pull!").

Isometric: the command and intent is to maintain the position in space (command is "hold!")

Verbal and Visual Cues:

Verbal commands assist in developing communication between the therapist and patient. The brevity, specificity, and timing of

verbal cues are critical to optimal patient response. Visual input is key to developing coordinated use of the body, especially in cases of sensory loss. One or two word commands are BEST; let your hand placement and tactile cues communicate the rest of the instructions. Make sure that the patient WATCHES their motion while learning each pattern.

Both are used to:

- Identify the desired direction of movement
- Facilitate the amount and type of response desired
- Direct the movement of the body with the movement pattern desired

TECHNIQUES:

The following key techniques will be described, with video demonstrations of the techniques with the use of different patterns.

- Quick Stretch
- Rhythmic Initiation
- Repeated Contractions
- Slow Reversals
- Hold Relax
- Contract Relax
- Rhythmic Stabilization
- Alternating Isometrics
- Resisted Progression

Remember that these techniques can facilitate the desired response for most movements of the limb girdles, extremities, or whole body.

Rhythmic Initiation:

Begins with passive motion to familiarize the client with the desired direction and sequence of motion. Rhythmic initiation progresses to active motion to teach the client to do the motion. Finally rhythmic initiation progresses to resisted movements that enable strengthening the motion to functional levels. It usually works best to have the client initiate the movement with the distal components first. That way the therapist can use their distal hand better to guide the motion. This technique is always uni-directional in a PNF pattern. Use Rhythmic Initiation to teach the desired pattern of movement and to assess the range of motion and gross strength. Can work effectively to improve:

- speed of movement
- direction of movement
- quality of movement
- strength or endurance

Repeated Contractions:

Used with isotonic contractions that are weaker at some point(s) in the range of motion. The therapist repeats the quick stretch and the

verbal cue whenever the motion slows below the desired pace or weakens. This enhances the active control of the motion and strength. At the point in the range of motion where the contraction weakens, repeat the initial quick stretch and verbal command (i.e. "and pull farther" or "pull harder") and reduce your resistance. When the motion slows too much, reapply your quick stretch, reduce you resistance, and command "pull faster". Be sure that you allow the motion to be fast enough by "yielding your resistance" at the correct speed.

Reversals of Antagonists:

Reversal of Antagonists includes contraction of the agonist followed by contraction of antagonist. This facilitates coordinated "changes of direction" in a movement pattern for daily function. This technique first commands motion in one direction of a diagonal pattern then (after a quick change in therapist manual contact) commands the opposite direction of motion. It is a repeating cycle of alternating contractions of antagonistic muscle groups. Slow reversal works on isotonic contractions and promotes smooth reversal of motion. Rhythmic stabilization works on isometric contractions and promotes stability at the target joint.

1. **Slow reversals:** Reversal of isotonic contractions through all or part of the available ROM. Commands might be (therapist uses manual contact to resist agonists) "now push", client goes through one direction of the motion; (therapist changes manual contacts to resist antagonists). Therapist commands "now pull" and client returns in the opposite direction of the motion. Used to improve:

- dynamic strength
- coordination
- kinesthetic awareness
- endurance
- active range of motion

2. **Rhythmic stabilization:** Isometric contraction of antagonistic muscle groups either simultaneously or alternately. Commands would be (therapist uses manual contact to resist agonists) "now hold"...(therapist changes manual contacts to resist antagonists)..."now hold". To achieve a maximal response, it is necessary to resist both the diagonal and rotational components. Compression into the proximal joints will further facilitate stability.

Used to improve:

- stability
- control of posture
- balance
- relaxation and pain reduction
- range of motion

Combination of Isotonics:

Combination of Isotonics involves concentric (shortening) and eccentric (lengthening) contractions in one direction, without any relaxation. They promote controlled strong movements through some or all of the available ROM. There are three types of

contractions: concentric, eccentric, and maintained isotonics (alternate concentric and eccentric). Commands might be "pull your hand up.....let me pull it down slowly" repeat this for several cycles as appropriate to the target ADL. Daily function consists of the coordination of all three types of muscle contractions. Combination of isotonics is particularly helpful when patients are limited in strength or smooth control in specific points in the range of motion. The ultimate goal is re-integration into functional activity. Generally used to improve:

- strength in a focused part of the ROM
- the ability to alternate between concentric and eccentric contractions
- better control of more range of motion
- initiation of movement in different parts of available range

Many activities do not occur throughout the entire available range of motion. For example, sit to stand from a high chair, or walking down stairs. An individual may have no functional problems in mid-range, but may not function well at the shortened or lengthened extremes of muscle range of motion. An example is the common difficulty patients have in controlling descent into a low chair. The quads just get beyond their optimal length for eccentric control and the client "plops" into the chair. In this case the therapist might do combination of isotonics in the range of hip and knee motion associated with a low chair. Then the patient would progress to practicing controlled sitting on lower and lower chairs.

Hold Relax:

This technique is effective for increasing ROM due to muscle tightness and also works well in the presence of mild to moderate pain. The key to effective hold relax technique is applying and releasing the resistance in a smooth and gradual way to minimize patient discomfort. This way the therapist can regulate the resistance so that it does not increase the pain. If pain persists with gentle contractions or prevents significant relaxation, try gentle active assistive exercise first. Hold Relax description: Take the extremity through the available ROM to where the restriction begins, but client is still comfortable. Gently resist all components of the tight muscle pattern, with emphasis on rotation. Commands might be "hold gently..now a little stronger...hold...now let go some...now relax completely". MAKE SURE THE CLIENT RELAXES FULLY, this is critical. Next the therapist moves the extremity further into the well-tolerated restricted range (but not to the point of pain) and repeats the hold....relax. The therapist repeats the cycles until there is no further gain in ROM. Gentle traction during the contractions helps minimize joint pain. Can do Hold Relax by contracting the "tight" muscles (providing improved direct relaxation after the contraction) or by contracting the "opposite" muscles (enabling improved relaxation of the tight muscles indirectly, by reciprocal inhibition).

Hold Relax is useful for:

increasing range of motion (with and without mild to moderate pain)

initiation of movement

Contract Relax:

Contract Relax uses a concentric contraction of the tight muscle (direct relaxation), or of the opposing muscles (indirect relaxation) and is otherwise much like Hold Relax. Resist all components of the pattern with concentration on rotational component. Do not allow any significant motion through the ROM. The contraction is followed by complete relaxation of the body part, and active or passive movement in the direction that lengthens the restricted soft tissues. Commands might be "pull...pull...pull...now relax...let go completely". THIS TECHNIQUE IS NOT Preferred WHEN PAIN ISPRESENTINTHEMOVEMENTPATTERN.(Thereasonthat Hold Relax works better in the presence of pain is that the therapist controls the gradual onset of contraction and can much better KEEP the contractions gentle enough. In Contract Relax, when a therapist gives a "Pull" or "Push" command, the client determines how much he/she will pull or push. In the presence of pain, clients have muscle guarding and find it difficult to push or pull just a "little".)

Contract Relax is useful for:

range of motion (only without pain)

initiation of movement

The following chart provides a summary of PNF in relation to Margaret Rood's (one of the foremothers of physical therapy) Stages of Control. Although originally describing only developmental stages of motor control, the concepts were

expanded to the recovery of movement in adults. With current evidence, it is understood that the nervous system of adults recover differently than the nervous system develops in children.

However, Rood has provided a conceptual framework into which the application of the different elements of PNF can be organized.

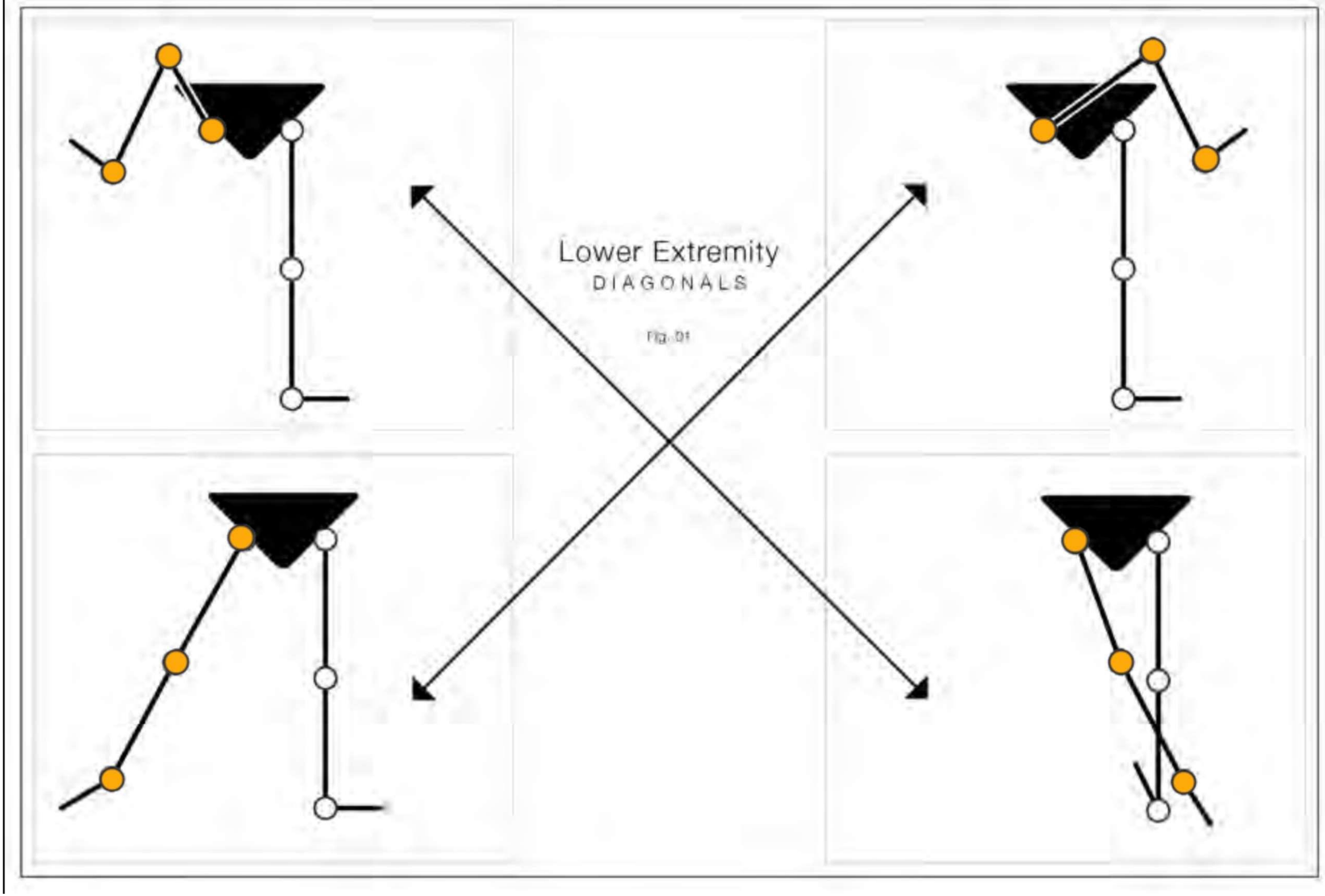
Table 1.1.1 Stages of Motor Control Associated with Proprioceptive Neuromuscular Facilitation

STAGES OF CONTROL	GENERAL GOALS	PNF TECHNIQUES	SAMPLE TREATMENT ACTIVITIES
MOBILITY	•Increase ROM •Increase initiation of range of motion.	•Hold Relax (HR), Contract Relax (CR), Rhythmic stabilizations (RS), Rhythmic rotation, Joint mobilization •HR-active movement, Repeated Contractions	For a patient with decrease in shoulder joint mobility, incorporate Rhythmic Rotation into PROM exercises to facilitate relaxation, especially in a patient with pain and hypertonia. For a patient with a limitation in ROM, particularly when pain is accompanying, Hold Relax can be used which includes an isometric contraction at the end point of the range, followed by relaxation and movement to new point of limitation.
STABILITY	•Sustained isometric contractions in shortened range for increasing duration •Coordinated isometric contractions in midline or weight bearing postures	•Shortened-held resisted contractions (SHRC) •Alternating Isometrics, RS	For a patient who has difficulty standing maintaining LE extension, SHRC as a Quad and Glut set in supine, held for 10 seconds to gain stability across the joints in non-weight bearing to prepare for weight-bearing. For a patient with difficulty stabilizing in standing or sitting and in order to facilitate smooth performance of isometric contractions in all three planes simultaneously, you could use RS at the trunk.

Figure 1.1 Stages of Motor Control Associated with Proprioceptive Neuromuscular Facilitation (cont)

STAGES OF CONTROL	GENERAL GOALS	PNF TECHNIQUES	SAMPLE TREATMENT ACTIVITIES
CONTROLLED MOBILITY	•Weight-shifting in weight bearing postures: AP, lateral, rotation. Also, reversal of antagonists or concentric-eccentric contractions; trunk rotations	•Slow-reversal hold, slow reversal, agonistic reversals	For the patient who shows difficulty in eccentric contractions in stand to sit, you could have the patient in the position and have the patient "make you work at pushing him/her down" into sitting using the technique of agonistic reversals.
SKILL	•Proximal dynamic stability •Normal timing and sequencing of movement •Trunk counter-rotation •Locomotion and Manipulation (ADLs) •Communication	•Shortened-held resisted contractions (SHRC) •Alternating Isometrics, RS	For a patient who has difficulty standing maintaining LE extension, SHRC as a Quad and Glut set in supine, held for 10 seconds to gain stability across the joints in non-weight bearing to prepare for weight-bearing. For a patient with difficulty stabilizing in standing or sitting and in order to facilitate smooth performance of isometric contractions in all three planes simultaneously, you could use RS at the trunk.

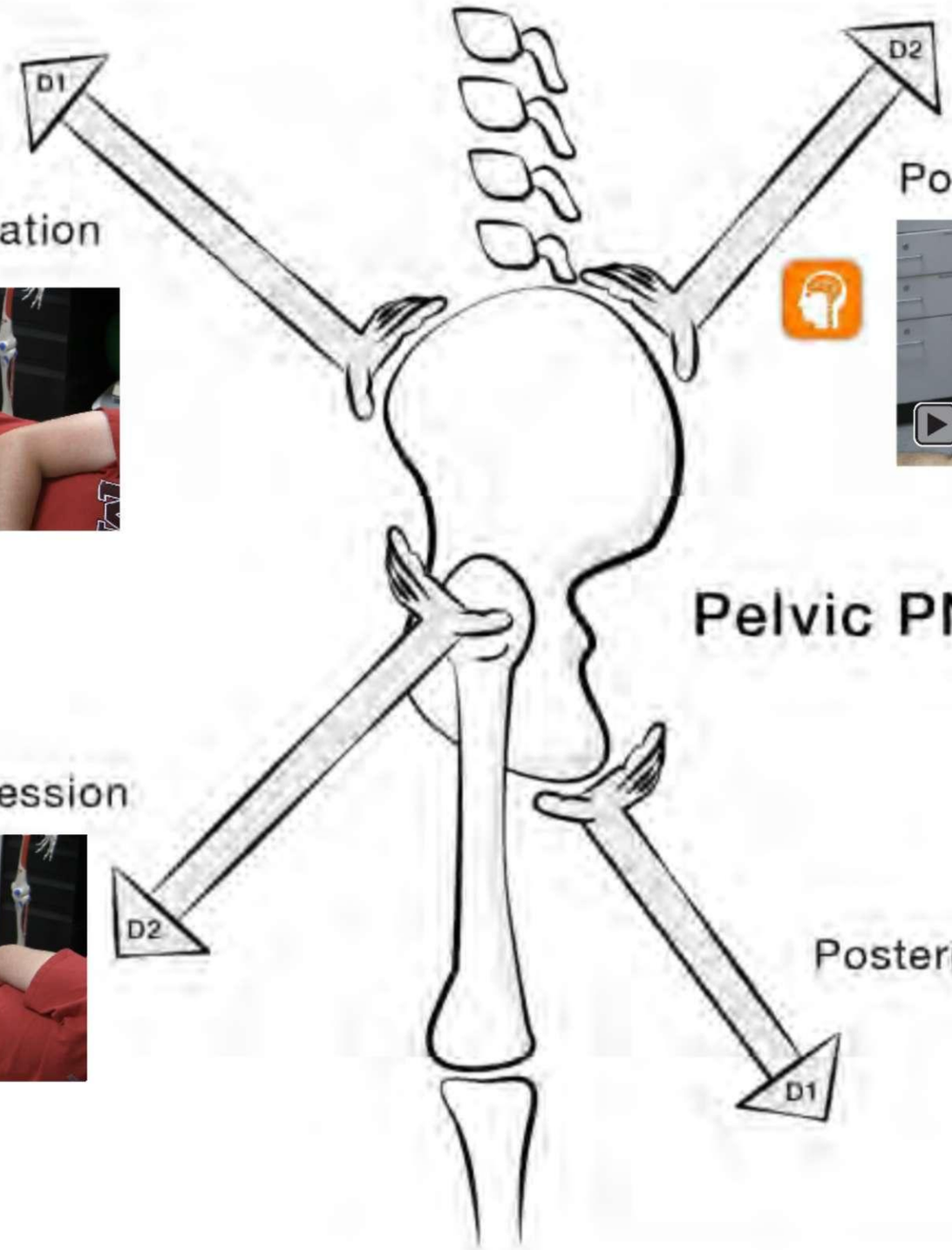
Click a touchpoint for more information



Lower Extremity D1 Flexion and Extension demonstrating rhythmic initiation, quick stretch and reversal of agonists

Lower Extremity D2 Flexion and Extension demonstrating rhythmic initiation, quick stretch and reversal of agonists

Pelvic PNF Patterns

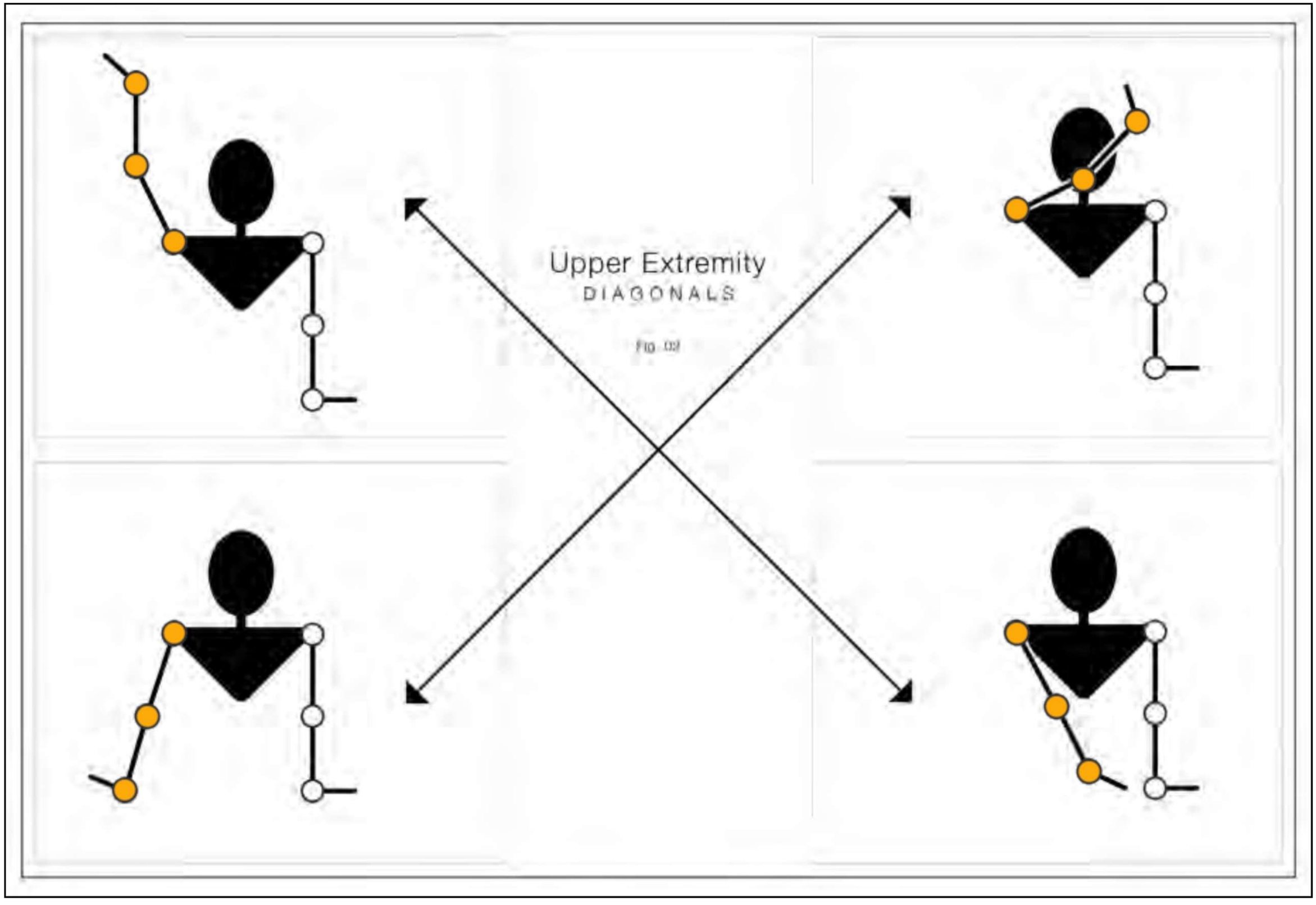


Anterior Elevation

Posterior Elevation

Anterior Depression

Posterior Depression


Upper Extremity
DIAGONALS
Fig. 02

Upper Extremity D1 Flexion and Extension demonstrating rhythmic initiation, quick stretch and reversal of agonists

Upper Extremity D2 Flexion and Extension demonstrating rhythmic initiation, quick stretch and reversal of agonists

Scapular PNF Patterns