

Table 2

ELECTROMYOMETRIC TESTING AND TREATMENT OF DEVELOPMENTAL REFLEXES

FIRST STAGE DEVELOPMENTAL REFLEXES

1. Flexor Withdrawal

Test

The patient should be in a supine position with the head in midline and lower extremities fully extended. The sole of the foot should be stimulated with a thumb stroke from the heel base and across the plantar surface of the arch toward the toes (the test stimulus). A positive response will result in an uncontrolled flexion of the stimulated appendage and a spontaneous increase in electromyometric activity from the hip flexor, hamstring group, tibialis anterior or long toe extensor muscles.

Facilitation

The patient should be supine with the head in midline. The involved hip and knee should be fully extended. The test stimulus should be applied¹ as the patient simultaneously attempts to increase myoelectric activity from the hip flexor, hamstring group, tibialis anterior or long toe extensor muscles.² When voluntary myoelectric activity has developed in the selected prime mover, in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of the muscle. The joint should be progressively flexed in 30° increments to the end of range. The patient should be able to voluntarily generate four-microvolts (mv) of myoelectric activity from the prime mover as the test stimulus is applied before advancing from one increment to the next.³ The involved joint should be supported or fixed in each position during facilitation attempts. This procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assumed and the test stimulus applied.

Inhibition

The patient should be lying supine with the involved hip and knee positioned in full flexion and the ankle in neutral range. When full inhibition of myoelectric activity (below two-mv) has been demonstrated in each of the selected prime moving muscle (hip flexors, hamstring group, tibialis anterior or long toe extensors), the test stimulus should

1 Rest periods between each stimulus application, varying from 10-seconds to several minutes (depending on the response of the individual patient), should be observed to avoid stimulus accommodation or desensitization by the skin receptors.

2 Each muscle, at each stage, should be monitored independently, and the desired response should be elicited from each of the muscles important to the reflex pattern.

3 Microvolt levels spoken of here are relative to the EMM produced by Biofeedback Research Institute.

be applied and the patient asked to simultaneously attempt to keep the resulting spontaneous myoelectric response below two-mv. When the patient is able to do this, in the initial position, the involved joint should be passively repositioned to promote prime mover inhibition of reflex myoelectric activity in a lengthened range. The joint should be progressively extended in 30° increments to the end of range. Advancement from one increment to the next should not occur until full inhibition of myoelectric activity from the prime mover is demonstrated while the stimulus is being applied. The involved joint should be supported in each position while the inhibition attempts are being made. Eventually this procedure should allow the patient to assume the test position and receive the test stimulus without a spontaneous increase in myoelectric activity from the involved prime moving muscles.

2. Extensor Thrust

Test

The patient should be lying supine with the head in midline. The uninvolved lower extremity should be extended and the involved lower extremity should have the hip and knee flexed to 90°. The sole of the foot, on the flexed side, should be stimulated with a thumb stroke delivered from the heel and across the surface of the arch toward the toes (the test stimulus). The positive response will result in an uncontrolled extension of the flexed leg with a marked plantar flexion and inversion of the ankle, and a spontaneous increase of myoelectric activity from the gluteus maximus, quadriceps group, gastrocnemius and posterior tibialis muscles.

Facilitation

The patient should be lying supine with the head in midline. The uninvolved lower extremity should be extended and the involved lower extremity should be positioned in full flexion. The test stimulus should be applied as the patient simultaneously attempts to increase myoelectric activity in the gluteus maximus, quadriceps group, gastrocnemius or posterior tibialis muscles on the involved side.⁴ When the selected prime mover has developed voluntary myoelectric activity, in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The joint should be progressively extended in 30° increments to the end of range. The patient should be able to voluntarily generate four-my of myoelectric activity from the prime mover as the test stimulus is applied, before advancing from one increment to the next. The involved joint should be supported or fixed in each position during facilitation attempts. This procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assumed and the test stimulus applied.

⁴ Rest periods between each stimulus application, varying from 10-seconds to several minutes (depending on the response of the individual patient), should be observed to avoid stimulus accommodation or desensitization by the skin receptors.

Special Note: Some muscles in a reflex pattern may be more responsive than others.

Inhibition

The patient should be lying supine with the involved lower extremity positioned in full extension. When full inhibition of myoelectric activity (below two-mv) in the selected prime mover muscle (gluteus maximus, quadriceps group, gastrocnemius or posterior tibialis) has been demonstrated, the test stimulus should be applied, and the patient asked to simultaneously attempt to keep the resulting spontaneous myoelectric response below two-mv. When the patient is able to do this, in the initial position, the involved joint should be passively repositioned to promote prime mover inhibition of reflex myoelectric activity in a lengthened range. The joint should be progressively flexed in 30° increments to the end of range. Advancement from one increment to the next should not occur until full inhibition of myoelectric activity from the prime mover is demonstrated while the test stimulus is being applied. The involved joint should be supported in each position, while the inhibition attempts are being made. Eventually, this procedure should allow the patient to assume the test position and receive the test stimulus without a spontaneous increase in myoelectric activity from the involved prime moving muscles.

3. Crossed Extension (1)

Test

The patient should be supine with the head in midline. The uninvolved lower extremity should be extended and the involved lower extremity should have the hip and knee flexed to 90°. The therapist should then flex the patient's extended lower extremity (the test stimulus). A positive response will result in involuntary extension of the flexed lower extremity, and a spontaneous increase in myoelectric activity from the gluteus maximus, quadriceps group, gastrocnemius and anterior tibialis muscles.

Facilitation

The patient should be lying supine with the head in midline. The uninvolved lower extremity should be extended and the involved lower extremity supported with the hip and knee in fully flexed positions. The patient should be asked to increase myoelectric activity from the gluteus maximus, quadriceps group, gastrocnemius, or posterior tibialis muscles of the flexed lower extremity as the therapist simultaneously applies the test stimulus. When the selected prime mover has developed voluntary myoelectric activity, in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range, to promote physiological shortening of that muscle. The joint should be progressively extended in 30° increments to the end of range. The patient should be able to voluntarily generate four-mv of myoelectric activity from the prime mover as the test stimulus is applied before advancing from one increment to the next.⁵ The involved joint should be supported or fixed in each position during the facilitation attempts. This procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assumed and the test stimulus applied.

⁵ Rest periods between each stimulus application, varying from 10-seconds to several minutes (depending on the response of the individual patient), should be observed to avoid accommodation or desensitization to the stimulus by the muscle receptors.

Inhibition

The patient should be lying supine with both legs extended. When full inhibition of myoelectric activity (below two-mv) from the selected prime moving muscle (gluteus maximus, quadriceps group, gastrocnemius or posterior tibialis) has been demonstrated on the involved side, the test stimulus should be applied and the patient asked to simultaneously attempt to keep the resulting spontaneous myoelectric response below two-mv. When the patient is able to do this, in the initial position, the involved joint should be passively repositioned to promote prime mover inhibition of reflex myoelectric activity in a lengthened range. The joint should be progressively flexed in 30° increments to the end of range. Advancement from one increment to the next should not occur until full inhibition of myoelectric activity from the prime mover is demonstrated while the stimulus is being applied. The involved joint should be supported in each position while the inhibition attempts are being made. Eventually this procedure should allow the patient to assume the test position and receive the test stimulus without a spontaneous increase in myoelectric activity occurring from the involved prime mover muscles.

4. Crossed Extension (2)

Test

The patient should be lying supine the head in midline, with the knees and hips extended, each hip abducted to 15° and externally rotated. The therapist should apply the test stimulus by tapping the medial surface of one of the thighs (the uninvolved thigh). If a positive response occurs, the opposite hip (the involved hip) will spontaneously adduct and internally rotate, the knee will extend and the ankle will plantar flex and invert (*Scissor position*), and an increase in spontaneous myoelectric activity from the quadriceps group, gluteus minimus, hip adductor group, gastrocnemius and posterior tibialis muscles.

Facilitation

The patient should be lying supine with the head in midline. The involved knee and ankle should be supported or fixed in 90° of flexion with the hip abducted 30°, externally rotated to approximately 45° and supported or fixed in 30° of flexion. The therapist should apply the test stimulus (tap the medial surface of the uninvolved thigh) as the patient simultaneously attempts to increase myoelectric activity from the quadriceps group, gluteus minimus, hip adductor group, gastrocnemius or posterior tibialis muscles in the involved lower extremity.⁶ When the selected prime mover has developed voluntary myoelectric activity in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The respective knee and ankle joints should be progressively extended and plantar flexed in 30° increments, while the hip is extended and internally rotated in 15° increments to the end of their respective ranges. The patient should be able to voluntarily generate four-mv of myoelectric activity from the chosen prime mover, as the test stimulus is applied, before advancing from one increment to the next. This procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assumed and the test stimulus applied.

⁶ Rest periods between each stimulus application, varying from 10-seconds to several minutes (depending on the response of the individual patient), should be observed to avoid accommodation or desensitization by the muscle receptors.

Inhibition

The patient should be lying supine with the head in midline. The involved knee and ankle should be extended and plantar flexed, with the hip extended and supported in internal rotation. When full inhibition of myoelectric activity (below two-mv) from the selected prime moving muscle (quadriceps group, gluteus minimus, hip adductor group, gastrocnemius or posterior tibialis) has been demonstrated, the test stimulus should be applied by tapping the medial surface of the opposing thigh as the patient simultaneously attempts to keep the resulting spontaneous myoelectric response below two-mv. When the patient is able to do this in the initial position, the involved joint should be passively repositioned to promote prime mover inhibition of reflex myoelectric activity in a lengthened range. The hip and knee should be progressively flexed, respectively, in 30° increments to approximately 90°. The hip should be progressively externally rotated and flexed in 15° increments to 45° and 30°, respectively. Advancement from one increment to the next should depend upon the patient's ability to demonstrate full inhibition of myoelectric activity from the prime mover as the stimulus is being applied. The involved joint should be supported in each position while the inhibition attempts are being made. Eventually, this procedure should allow the patient to assume the test position and receive the test stimulus without a spontaneous increase in myoelectric activity from the involved prime movers.

SECOND STAGE DEVELOPMENTAL REFLEXES

5. Tonic Labyrinthine Supine

Test

The patient should be lying supine, with the head in midline and the upper and lower extremities extended. The position itself is the test stimulus. A positive response will result in an involuntary increase in muscle tone and a spontaneous increase in myoelectric activity in the triceps, wrist extensor, quadriceps group and gluteus maximus muscles as the involved joints are passively flexed.

Facilitation

The patient should be lying supine with the head in midline and the upper and lower extremities fully flexed. The patient should attempt to increase myoelectric activity from the triceps, wrist extensor, quadriceps group or gluteus maximus muscles. When voluntary myoelectric activity has developed in the selected prime mover in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The joint should be progressively extended in 30° increments to the end of range. The patient should be able to voluntarily generate four-mv of myoelectric activity from the prime mover before advancing from one increment to the next. The involved joint should be supported or fixed in each position during the facilitation attempts. This procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assumed.

Inhibition

The patient should be lying supine with the head in midline and the involved joints respectively supported or fixed in full extension. When full inhibition of myoelectric activity (below two-mv) from the selected prime covering muscle (triceps, wrist extensors, quadriceps group or gluteus maximus) has been demonstrated in the initial position, the involved joint should be progressively flexed in 30° increments to the end of range. Advancement from one increment to the next should occur only when full inhibition of myoelectric activity from the prime cover has been demonstrated. The involved joint should be supported in each position while the inhibition attempts are being made. Eventually this procedure should allow the patient to assume the test position without a spontaneous increase in myoelectric activity from the involved prime mover muscles. The patient should then increase and decrease myoelectric activity from those prime covers on command.

6. Tonic Labyrinthine Prone

Test

The patient should be lying prone with the head in midline with the lower extremities extended and the upper extremities extended above the head (if possible). The test stimulus is the position itself. A positive response will result in an involuntary increase in muscle tone in the biceps group, wrist flexor, finger flexor, thumb flexor, hip flexor, and hamstring group muscles, and a spontaneous increase in myoelectric activity from those muscles.

Facilitation

The patient should be lying prone with upper and lower extremities fully extended, or bending forward at the waist (to full hip flexion) while sitting with the knees as extended as the position will allow, and the upper extremity extended at the elbow, wrist and finger joints and the shoulder flexed to 90°. The patient should attempt to increase myoelectric activity in the hip flexor, hamstring group, biceps group, wrist flexor, finger-flexor or thumb flexor muscles. When voluntary myoelectric activity has developed in the selected prime mover in the initial position, the involved joint should be passively repositioned to facilitate prime cover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The joint should be progressively flexed in 30° increments to the end of range. The patient should be able to voluntarily generate four-mv of myoelectric activity in the prime cover before advancing from one increment to the next. The involved joint should be supported or fixed (utilizing tape or other devices) in each position during the facilitation attempts. Progression of the hip joint from full extension in a prone position is literally impossible on a flat surface unless special trunk support is supplied (with pillows or other improvised materials). The sitting position has proven effective for the facilitation of knee and upper extremity joint flexor prime movers.

Special note: *If a prime mover is facilitated by a reflex, its antagonist tends to be reciprocally inhibited. This mechanism offers an opportunity to augment the inhibitory effects of appropriately applied electromyometry in inhibition of dominant spastic muscles or muscle groups. This may be done by promoting a developmental reflex (by patient position and provocative stimulus), which facilitates the spastic muscle's antagonist while the patient simultaneously attempts to decrease myoelectric activity (or keep it below an appropriate my level) from the spastic muscle and to increase myoelectric activity from its antagonist. Joint range considerations and myoelectric activity limitations should be consistent with the **Facilitation** and **Inhibition** procedures described for the particular developmental reflex utilized.*

This procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assumed.

Inhibition

The patient should be lying prone with the upper and lower extremities fully flexed, or bending forward at the waist (to full hip flexion) while sitting with the knees as fully flexed, as the position will allow. When full inhibition of myoelectric activity (below two-mv) from the selected prime moving muscles (hip flexor, hamstring group, biceps groups, wrist flexors, finger flexors or thumb flexors) has been demonstrated in the initial position, the involved joint should be progressively extended in 30° increments to the end of range. Advancement from one increment to the next should occur only when full inhibition or myoelectric activity from the prime mover has been demonstrated. The involved joint should be supported in each position while the inhibition attempts are being made. It is recommended that the sitting position not be used for hip flexor inhibition because of the obvious problem of increasing joint extension range. Eventually, this procedure should allow the patient to assume the test position without a spontaneous increase in myoelectric activity from the involved prime mover muscles. The patient should then increase and decrease myoelectric activity from prime movers on command.

7. Positive Supporting Reaction

Test

If the patient is a child (or very light and small), the patient should be held in a standing position and bounced several times on the soles of the feet. A positive response will result in a spontaneous increase in myoelectric activity from the quadriceps, gastrocnemius, posterior tibialis and the long and short toe flexor muscles, involuntary extension of the knee, plantar flexion, inversion of the foot, clawing of the toes, and possibly genu recurvatum. Should the patient be an adult, it should be sufficient to have the patient stand and shift from the uninvolved foot to the involved foot to produce some or all of the symptoms listed above.

Facilitation

The patient should be standing with the greatest part of the body weight supported on the uninvolved lower extremity with the involved knee slightly flexed. The patient should slowly shift weight from the uninvolved lower extremity to the involved lower extremity (with the involved knee slightly flexed) while simultaneously attempting to increase myoelectric activity from the quadriceps group, gastrocnemius, posterior tibialis, long toe flexor or short toe flexor muscles. This should be repeated until voluntary myoelectric activity in excess of six-mv is produced from the selected prime mover. Eventually, the patient should demonstrate spontaneous myoelectric activity from each of the involved prime movers when weight is shifted to the involved lower extremity in a standing position.

Inhibition

The patient should be standing with the involved knee slightly flexed and with the greatest part of the body weight supported by the uninvolved lower extremity. When the patient has fully inhibited myoelectric activity (below two-mv) from the selected prime

mover muscle (the quadriceps group, gastrocnemius, posterior tibialis, long toe flexors or short toe flexors), in the initial position, she should slowly shift to the involved side as she simultaneously attempts to inhibit any myoelectric activity in that prime mover above the appropriate level (six-mv for the posterior tibialis, long toe and short toe flexors, and 12 to 15-mv for the quadriceps group and gastrocnemius). Eventually, the patient should be able to stand with weight equally distributed between both lower extremities without a spontaneous increase in myoelectric response from the involved prime mover, above the appropriate level.

8. Negative Supporting Reaction

Test

The patient, if a child, should be held in a standing position and bounced several times on the sole of the feet, and then held up in space. A *positive response* will result in a spontaneous increase in myoelectric activity from the hip and knee flexion. Myoelectric activity may also spontaneously occur from the gluteus minimus or hip external rotator group, and the gastrocnemius, posterior tibialis and anterior tibialis muscles with concurrent involuntary internal or external hip rotation, and ankle plantar flexion and foot inversion. If the patient is an adult, a positive response will result in the same symptoms as the patient attempts to put the involved foot on the floor and bear weight on it.

Facilitation

The patient should be standing with the greatest part of body weight supported on the uninvolved lower extremity. The patient should slowly shift her weight to the involved side and simultaneously attempt to increase myoelectric activity from the hip flexor and hamstring group muscles. This should be repeated until voluntary myoelectric activity in excess of six-mv is produced from the selected prime mover. Eventually, the patient should demonstrate spontaneous myoelectric activity from each of the involved prime movers when weight is shifted to the involved lower extremity in a standing position.

Inhibition

The patient should be standing with the greatest part of body weight supported on the uninvolved lower extremity. When the patient has fully inhibited myoelectric activity (below two-mv) from the selected prime mover muscles (the hip flexors, hamstring group or other involved muscles, as suggested by the *positive test response*), in the initial position, she should slowly shift to the involved side as she attempts to simultaneously inhibit the myoelectric activity in that prime mover above the appropriate level (this level will vary depending on the muscle monitored, but should be between six and 12-mv for the hip flexors and hamstring group). Eventually, the patient should be able to stand with weight equally distributed between the lower extremities without a spontaneous increase in myoelectric response from the involved prime movers above the appropriate level.

9. Asymmetric Tonic Neck

Test

The patient should be lying supine with the head in midline and the upper and lower extremities extended and slightly abducted. The patient's face should then be voluntarily

or involuntarily turned to one side (the test stimulus). If the face is turned toward the involved side, a positive response will result in involuntary extension of both the upper and lower extremities (the lower extremity may also internally rotate) and a spontaneous myoelectric activity in the triceps, gluteus minimus, gluteus maximus and quadriceps group muscles. If the face is turned away from the involved side, a positive response will result in involuntary external rotation and abduction of the shoulder, and flexion of the elbow, hip and knee, inversion and plantar flexion of the foot and ankle, and a spontaneous increase in myoelectric activity in the infraspinatus, teres minor, biceps group, hip flexor, hamstring group and posterior tibialis muscles.

Facilitation

The patient should be either lying supine, prone or sitting and bending forward at the waist (to at least 45° of hip flexion). The position of choice will be determined by which position best facilitates myoelectric activity from the chosen prime moving muscle, and will, of necessity, be based on trial and error observation. In the chosen position, the patient should have the face turned toward one side and simultaneously attempt to voluntarily increase myoelectric activity from the selected prime mover (triceps, gluteus minimus, gluteus maximus or quadriceps group if the face is turned toward the involved side, and the infraspinatus, teres minor, biceps group, hip flexors, hamstring group or posterior tibialis if the face is turned away from the involved side). The involved joint should initially be in full extension if the prime mover is a joint flexor, in full flexion if the prime mover is a joint extensor, in full internal rotation if the prime mover is a joint external rotator, or in full external rotation if the prime mover is a joint internal rotator. The extremity of the range is dependent on the limitation imposed upon it by the patient's position. When voluntary myoelectric activity has developed in the chosen prime mover in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The joint should be progressed to the end of range in 30° increments. The patient should be able to voluntarily generate four-mv of myoelectric activity from the prime mover when the test stimulus is applied before advancing from one increment to the next. The involved joint should be supported or fixed in each position during the facilitation attempts. The procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assumed and test stimulus provided.

Inhibition

The patient should be either lying supine, prone or sitting and bending forward at the waist (to at least 45° of hip flexion). The position of choice will be determined by the position that best facilitates myoelectric activity from the chosen prime moving muscle, and will, of necessity, be based on trial and error observation. In the chosen position, the patient should have the face turned toward one side. When the patient has demonstrated full inhibition of myoelectric activity (below two-mv) from the selected prime mover muscle(s) (triceps, gluteus minimus, gluteus maximus or quadriceps groups if the face is turned toward the involved side, and the infraspinatus, teres minor, biceps group, hip flexors, hamstring group or posterior tibialis, if the face is turned away from the involved side) in the initial position, the involved joint should be passively repositioned to provide an opportunity for inhibition of prime mover myoelectric activity in a lengthened range to promote physiological lengthening of that muscle. Initially, the involved joint should be in full flexion if the prime mover is a joint flexor, in full extension if the prime mover is a joint extensor, in full external rotation if the prime mover is a joint external rotator, or in full internal rotation if the prime mover is a joint internal rotator (the range of the is

dependent upon the limitation imposed upon it by the patient's position). The involved joint should be progressed in 30° increments to the end of range. Advancement from one increment to the next should occur only when full inhibition of myoelectric activity from the prime mover has been demonstrated. The involved joint should be supported in each position while the inhibition attempts are being made. Eventually, the procedure should allow the patient to assume the test position and receive the test stimulus without a spontaneous increase in myoelectric activity from the involved prime mover muscles. The patient should then increase and decrease myoelectric activity from those prime covers *on command*.

THIRD STAGE DEVELOPMENTAL REFLEXES

10. Tonic Lumbar

Test

The patient should be lying supine with the head in midline. The patient's lumbar spine should be voluntarily or involuntarily rotated toward the involved side (the test stimulus). A positive response will result in involuntary upper extremity abduction and flexion, and lower extremity extension ("*ball throwing stance*"), and a spontaneous increase in myoelectric activity in the middle deltoid, supraspinatus, biceps group, gluteus maximus, quadriceps group, gastrocnemius and posterior tibialis muscles on the involved side.

Facilitation

The patient should be lying supine with the head in midline. The patient's lumbar spine should be voluntarily or involuntarily rotated toward the involved side (the test stimulus) while the patient simultaneously attempts to increase the myoelectric activity in the prime mover (middle deltoid, supraspinatus, biceps group, gluteus maximus, quadriceps group, gastrocnemius or posterior tibialis). The involved joint should initially be in full adduction if the prime mover is a joint abductor, in full extension if the prime mover is a joint flexor, in full flexion if the prime mover is a joint extensor, in full ankle dorsiflexion if the prime mover is a plantar flexor, or in full foot eversion if the prime mover is a foot inverter. When voluntary myoelectric has developed in the selected prime mover in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The joint should be progressed to the end of range (90° of shoulder abduction is the end of range for the middle deltoid and supraspinatus muscles) in 30° increments. The patient should be able to voluntarily generate four-mv of myoelectric activity from the prime mover when the test stimulus is applied before advancing from one increment to the next. The involved joint should be supported or fixed in each position during the facilitation attempts. This procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assured and the test stimulus provided.

Inhibition

The patient should be lying supine with the head in midline. The patient's lumbar spine should be voluntarily or involuntarily rotated toward the involved side (the test stimulus) and supported in that position. When the patient has demonstrated full inhibition of

myoelectric activity (below two-mv) from the selected prime mover muscle(s) (middle deltoid, supraspinatus, biceps group, gluteus maximus, quadriceps group, gastrocnemius or posterior tibialis) in the initial position, the involved joint should be passively repositioned to provide an opportunity to inhibit prime mover myoelectric activity in a lengthened range to promote physiological lengthening of that muscle. Initially, the involved joint should be in full abduction (90° of shoulder abduction for the middle deltoid and supraspinatus muscles) if the prime mover is a joint abductor, in full flexion if the prime mover is a joint flexor, full extension if the prime mover is an ankle joint plantar flexor or in full foot inversion if the prime mover is a foot inverter. The involved joint should be progressed in 30° increments to the end of range. Advancement from one increment to the next should occur only when full inhibition of myoelectric activity from the prime mover is demonstrated. The involved joint should be supported in each position the inhibition attempts are being made. Eventually, this procedure should allow the patient to assume the test position and receive the test stimulus without a spontaneous increase in myoelectric activity occurring from the involved prime mover muscles. The patient should then increase and decrease myoelectric activity from those prime movers on command.

FOURTH STAGE DEVELOPMENTAL REFLEXES

11. Symmetrical Tonic Neck (1)

Test

The patient should be sitting with the hips and knees in 90° of flexion with the feet off the floor and the head in midline. The patient should bend forward at the waist (to full flexion of the hips, limited by the position and the comfort of the patient) and ventroflex the neck (the test stimulus). A positive response will result in involuntary flexion of the elbow, wrist, fingers and thumb, and extension of the knee, plantar flexion and inversion of the ankle and foot, and/or a spontaneous increase in myoelectric activity from the biceps group, wrist flexor, finger flexor, thumb flexor, quadriceps group, gastrocnemius and posterior tibialis muscles.

Facilitation

The patient should be sitting with the hips in 90° of flexion with the involved knee and the head in midline and positioned and supported in as much flexion as the position will permit. The patient should bend forward at the waist (to full flexion of the hips, limited by the position and the comfort of the patient) and ventroflex the neck (the test stimulus) while simultaneously attempting to increase myoelectric activity from the selected prime mover muscle(s) (biceps group, wrist flexor, finger flexor, thumb flexor, quadriceps group, gastrocnemius or posterior tibialis). The involved joint should initially be in full extension if the prime mover is a joint flexor, in full flexion if the prime mover is a joint extensor, in full dorsiflexion if the prime mover is an ankle plantar flexor, or in full eversion if the prime mover is a foot inverter. When voluntary myoelectric activity has developed in the prime mover, in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The joint should be progressed to the end of range in 30° increments. The patient should be able to voluntarily generate four-mv of myoelectric activity from the prime mover when the test stimulus is applied before advancing from one increment to the next. The involved joint should be supported or

fixed in each position during the facilitation attempts. This procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assumed and the test stimulus is performed.

Inhibition

The patient should be sitting with the head in midline and the hips in 90° of flexion with the involved knee positioned and supported in as much extension as the position will permit. The patient should bend forward at the waist (to full flexion of the hips limited by the position and the comfort of the patient) and ventroflex the neck (the test stimulus). When the patient has demonstrated full inhibition of myoelectric activity (below two-mv) from the selected prime mover muscle(s) (biceps group, wrist flexor, finger flexor, thumb flexor, quadriceps group, gastrocnemius or posterior tibialis) in the initial position, the involved joint should be passively repositioned to provide an opportunity to inhibit prime mover myoelectric activity in a lengthened range to promote physiological lengthening of that muscle. Initially, the involved joint should be in full flexion if the prime mover is a joint flexor, in full extension if the prime mover is a joint extensor, in full plantar flexion if the prime mover is a plantar flexor, or in full inversion if the prime mover is a foot inverter. The involved joint should be progressed in 30° increments to the end range.

Advancement from one increment to the next should occur only when full inhibition of myoelectric activity from the prime mover has been demonstrated. The involved joint should be supported in each position while the inhibition attempts are being made. Eventually, this procedure should allow the patient to assume the test position and the test stimulus performed without a spontaneous increase in myoelectric activity occurring from the involved prime mover muscles. The patient should then increase and decrease myoelectric activity from those prime movers on command.

12. Symmetric Tonic Neck (2)

Test

The patient should be lying prone with the head in midline and the involved upper extremity extending over the edge of the supporting platform (plinth, bed or table), or sitting and bending forward at the waist (to full flexion of the hips limited by the position and comfort of the patient) with the feet off the floor. The patient should dorsiflex the neck (the test stimulus). A positive response will result in involuntary flexion of the shoulder, extension of the elbow, wrist, finger and thumb, and flexion of the hip and knee, or a spontaneous increase in myoelectric activity from the anterior deltoid, triceps group, wrist extensor, finger extensor, thumb extensor, hip flexor and hamstring group muscles.

Facilitation

The patient should be lying prone with head in midline and the involved upper extremity extending over the edge of the supporting platform, or sitting and bending forward at the waist (to full flexion of the hips limited by the position and the comfort of the patient) with the knees positioned and supported in as much extension as the position will permit. The choice of position will depend upon trial and error observation that will establish the position that best facilitates myoelectric activity of the selected prime mover. The patient should dorsiflex the neck (test stimulus) and simultaneously attempt to increase

myoelectric activity from the selected prime mover muscle(s) (anterior deltoid, triceps group, wrist extensors, finger extensors, thumb extensors, hip flexors or hamstring group). The involved joint should initially be in full extension if the prime mover is a joint flexor and in full flexion if a joint extensor (see **Tonic Labyrinthine Prone** for hip joint range considerations). When voluntary myoelectric activity has developed in the prime mover, in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The joint should be progressed to the end of range in 30° increments (the end of range for the anterior deltoid is 90° of shoulder flexion). The patient should be able to voluntarily generate four-mv of myoelectric activity from the prime mover when the test stimulus is applied before advancing from one increment to the next. The involved joint should be supported or fixed in each position during the facilitation attempts. This procedure should eventually enable the patient to demonstrate spontaneous myoelectric activity from each of the involved prime movers when the test position is assumed and the test stimulus performed.

Inhibition

The patient should be lying prone with the head in midline and the involved upper extremity extending over the edge of the supporting platform, or sitting while bending forward at the waist (to full flexion of the hips limited by the position and the comfort of the patient) with the knees positioned and supported in as much flexion as the position will permit (the choice of position will depend upon trial and error to determine which position best facilitates myoelectric activity of the selected prime mover). The patient should dorsiflex the neck (test stimulus). When the patient has demonstrated full inhibition of myoelectric activity (below two-mv) from the selected prime mover muscle(s) (anterior deltoid, triceps group, wrist extensors, finger extensors, thumb extensors, hip flexors or hamstring group), in the initial position, the involved joint should be passively repositioned to provide an opportunity to inhibit prime mover myoelectric activity in a lengthened range to promote physiological lengthening of that muscle. Initially, the involved joint should be in full flexion (90° of shoulder for the anterior deltoid) if the prime mover is a joint flexor, and in full extension if the prime mover is a joint extensor (see **Tonic Labyrinthine Prone** for hip joint range considerations). The involved joint should be progressed in 30° increments to the end of range. Advancement from one increment to the next should be permitted only when full inhibition of myoelectric activity from the prime mover has been demonstrated. The involved joint should be supported in each position while the inhibition attempts are being made. Eventually, this procedure should allow the patient to assume the test position and the test stimulus performed without a spontaneous increase in myoelectric activity from the involved prime mover muscles. The patient should then increase and decrease myoelectric activity from those prime movers on command.

FIFTH STAGE DEVELOPMENTAL REFLEXES

13. Contralateral Associative Reactions

Test

The patient should be in the position appropriate for *muscle testing* of the muscle being monitored on the involved side (Daniels, Williams and Worthington, 1956). The patient should contract the same muscle on the uninvolved contralateral side (this should be done

against resistance if no response is generated from the monitored muscle without resistance). A positive response will result in an involuntary contraction and/or a spontaneous increase in myoelectric activity from the monitored muscle. A positive response may also be a contraction of a contralateral muscle that is related to the monitored muscle by virtue of a synergistic pattern common to both (contralateral synkinesis, see **Table 5**).

Facilitation

The patient should be in the position appropriate for *muscle testing* of the prime moving muscle being monitored. The patient should attempt to increase myoelectric activity from the prime mover as she contracts the selected contra lateral prime mover (with or without resistance). When voluntary myoelectric activity has developed in the involved prime mover, in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The involved joint should be progressively repositioned in 30° increments to the end of range. The patient should be able to voluntarily generate four-mv of myoelectric activity from the prime mover before advancing from one increment to the next. The involved joint should be supported or fixed in each position during facilitation attempts. The procedure may be repeated in other positions (lying, sitting, or standing) to promote muscle activity in more functional positions. Eventually, the patient should be able to demonstrate spontaneous myoelectric activity from the involved prime mover muscle when the test position is assumed and the contralateral muscle contracted, with or without resistance.⁷

Inhibition

The patient should be in the position appropriate for *muscle testing* of the prime moving muscle being monitored on the involved side, with the muscle at its shortest length. When full inhibition of myoelectric activity (below two-mv) from the prime mover has been demonstrated, in the initial position, the patient should contract the selected contralateral prime mover (see Tables 3, 4, and 5) against resistance as she attempts to inhibit myoelectric activity from the involved prime mover. The contraction of the contralateral muscle should gradually increase in force until a maximum contraction is attained, as the patient inhibits myoelectric activity from the involved prime mover (below two-mv). The involved joint should then be passively repositioned to provide an opportunity to inhibit myoelectric activity in the prime mover in a lengthened range to promote physiological lengthening of that muscle. The involved joint should be progressed in 30° increments to the end of range. Advancement from one increment to the next should occur only when full inhibition of myoelectric activity from the prime mover has been demonstrated. The involved joint should be supported in each position while the inhibition attempts are made. This procedure may be repeated in other positions (lying, sitting, or standing) to promote inhibition of muscle activity in more functional positions. Eventually, the patient should be able to assume the test position and voluntarily contract the selected contralateral muscle against resistance without a spontaneous increase in myoelectric activity from the involved prime mover muscle, regardless of the involved joint position. The patient should then increase and decrease myoelectric activity from that prime mover, on command, while simultaneously maintaining a contraction of the selected contralateral muscle against resistance.

⁷ This procedure may be used to augment the effect of other developmental reflexes being utilized to facilitate myoelectric activity from the involved musculature.

14. Homolateral Associative Reactions

Test

The patient should be in the position appropriate for muscle testing of the muscle being monitored (Daniels, Williams, and Worthington, 1956). The patient should contract a muscle against resistance on the same side of the body that belongs to the same synergistic pattern as the monitored muscle (see **Table 5**). A positive response will result in an involuntary contraction and/or a spontaneous increase in myoelectric activity from the muscle monitored (homolateral synkinesis). This relationship may be demonstrated between muscles in the same extremity and synergistic pattern, or between muscles in the upper and lower extremities, respectively, in complementary synergies (the flexion synergistic pattern of the upper extremity is complementary to the extension synergistic pattern of the lower extremity, and the upper extremity extension synergistic pattern is complementary to the flexion synergistic pattern of the lower extremity).

Facilitation

The patient should be in the position appropriate for *muscle testing* of the prime moving muscle being monitored on the involved side. The patient should attempt to increase myoelectric activity from the prime mover as she contracts a selected muscle against resistance in the same extremity, which belongs to the same synergistic pattern as the involved prime mover, or a muscle in the other extremity on the homolateral side, which belongs to the complementary synergistic pattern (see **Table 5**). When voluntary myoelectric activity has developed in the involved prime mover, in the initial position, the involved joint should be passively repositioned to facilitate prime mover myoelectric activity in a shortened range to promote physiological shortening of that muscle. The involved joint should be progressively repositioned in 30° increments to the end of range. The patient should be able to voluntarily generate four-mv of myoelectric activity from the prime mover before advancing from one increment to the next. The involved joint should be supported or fixed in each position during the facilitation attempts. This procedure may be repeated in other positions (lying, sitting, and/ or standing) to promote muscle activity in more functional positions. Eventually, the patient should be able to demonstrate spontaneous myoelectric activity from the prime mover when the test position is assumed and the homolateral selected synergistic muscle contracted against resistance.⁸

Inhibition

The patient should be in the position appropriate for *muscle testing* of the prime moving muscle being monitored, with the muscle at its shortest length. When full inhibition of myoelectric activity (below two-mv) from the prime mover has been demonstrated, in the initial position, the patient should contract the selected muscle from within the appropriate synergistic pattern on the homolateral side (see **Table 5**) against resistance as she attempts to inhibit myoelectric activity from the involved prime mover. The contraction of the selected muscle should gradually increase in force until a maximum

⁸ This procedure may be used to augment the effect of other developmental reflexes being utilized to facilitate myoelectric activity from the involved musculature.

contraction is attained as the patient inhibits myoelectric activity from the involved prime mover (below two-mv). The involved joint should then be passively repositioned to provide an opportunity to inhibit myoelectric activity in the involved prime mover in a lengthened range to promote physiological lengthening of that muscle. The involved joint should be progressed in 30° increments to the end of range. Advancement from one increment to the next should occur only when full inhibition of myoelectric activity from the prime mover has been demonstrated. The involved joint should be supported in each position while the inhibition attempts are made.