THE USE OF PATHOLOGICAL AND UNLOCKING REFLEXES IN THE REHABILITATION OF SPASTICS

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In pursuing further the studies on the origin of human movement, it became obvious that both the so-called "normal" and "pathological" reflexes, as retained and manifested in man, represented portions of semi-automatic and automatic responses encountered in the "patterns of movement" characteristic of the amphibian and reptile stages of evolution.

Many of the familiar reflexes, when induced with the patient on the abdomen (prone), in a surrounding media such as water (salt water preferred because of its buoyancy factor), or dry sand (offering a partial resistance factor), reproduce or imitate portions of patterns of projection and propulsion that were once common for this postural state, and are found to be present in the "normal" newborn infant (under similar circumstances) up to the fifth to sixteenth month of postnatal motor expression.

The Tonic Neck Reflex, for instance, is a meaningless extremity response in the decerebrate types when induced with the patient lying on the back. If the same patient is placed on the abdomen, and the head properly turned, a serialized initiation of the *amphibian* type of *homolateral* extremity response ensues, with semi-automatic reciprocation of the trunk and extremity movements as the head is rotated from side to side so that a crude *progression effect* of crawling results.

The important factor in such an integrated display of sequence coordination, is that the *purposeless jerky movements*, which result when the patient is observed on the back (supine) are immediately transformed into a smoother and serialized *purposeful pattern* of progression when on the abdomen. In the decerebrate types (without cortical control and suppression modification), the proper establishment of the "postural-vestibular" influence by the prone position and head movement, *initiates a caudal directed flow of neck-upper extremity-trunk-lower extremity* serialization and "unlocking" of muscles and muscle groups, in preparation for powerful projectional response, by the extremities, intended to drive the head-neck-trunk-visceral portions forward.

The amazing fact appears to be that under slow motion recording (presented elsewhere[2]) the movements of certain amphibians and the swimming turtles are

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The original paper was accompanied by a film demonstration. This film may be obtained by request to the author at 8800 Germantown Ave., Philadelphia 18, Penna.

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[2]American Congress of Physical Medicine and Rehabilitation, 1953.

almost identical with those of the decerebrate human in the prone position: or the "normal" motor (psychopathic patient) responses immediately following electric shock "therapy".[3]

The eye-head-neck movement (T.N.R.), apparently does not need the brain cortex to *start off* and *maintain* a large number of intrinsic cord reflexes that have become highly integrated below the level of the pons (section of the crus), if the individual is placed in the primitive prone position.

This agrees with the comparative anatomy studies on amphibians and reptiles, where excellent coordinated methods of projection and progression (slithering, hopping and walking) developed before the pallium evolved from a thin membranous structure, which was to become the cerebral cortex.

Confirmation is further established by embryological evidence that the reticular cells, concerned with the eye-head-trunk movements are situated near the walls of the aquaduct at the level of the pons, in the earliest vertebrate forms (Herrick). This reticulate cluster also dominates lower primitive levels through the reticular and the nucleate systems (Yakovlev).

Finally, the physiological evidence (Spiegel, Magoun, Peacock, and many others) indicates that a high degree of motor functional integration exists at the level of the pons and medulla which may be released from control by the cortex, and functions adequately, although blindly and purposelessly, as far as primitive patterns of movement and reflex activity are concerned.

As far as practical therapy is concerned, this all adds up to the fact that we have at our disposal a variety of ways *to make the muscles work*, even when the brain levels, above the crus, have been destroyed or impaired. Not only that but we have certain "made to order" exercises in the form of normal and pathological responses the way the spinal cord and muscles like to function. In spastic forms of paralysis we may choose to activate simple reflexes and by repeating either the "deep" or "superficial" (tendon or skin) stimulae, cause a single muscle or group of muscles to respond indefinitely, or to the state of fatigue, if so desired.

If there is no existing joint fixation, or tendon-muscle contracture, and the reflex arcs below the pons are intact, the therapist should have a "field day" (with the patient in the prone position, of course), simply scratching and tapping (with appropriate nontraumatizing equipment) and "letting nature take its course" or "doing what comes naturally."

These "built-in exercises" for the patient can easily be worked out for any portion of the body by a few mechanical aids. Besides all the popular "normal" deep tendon reflexes as *individual muscle exercisers*, groups of muscles can be aroused and coordinated by the "pathological" responses, known as the "Hoffman sign", "Babinski sign", "Ankle clonus", "Marie-Foix" (Sinkler) reflex, "Pussepp's sign", "Riddoch's Mass Reflex" and other so-called "defense" or "spinal mass reflexes."

By inducing, once or twice daily, 12 to 20 of these reactions in succession, not only does the spastic muscle function improve, its volume increases in a few weeks, and the response begins to automatically integrate into a wider and more

[3]American Psychiatric Association, May, 1942.

organized pattern, *with striking diminution in the spastic tone and postural disturbance* of the part. It would appear that the spastic type of paralysis, arising when cortical control and suppression is withdrawn, yields to influences of lower primitive centers when these are deliberately aroused and placed in command at the level of function for which they originally functioned.

There are more than 36 other neurologically nostalgic "signs" and "reflexes", to be put to work for the benefit of the patient, the contemplation of the younger generation in rehabilitation, and the consternation of those that continue to record "reflexes" (named and yet to be named) for their classical and meaningless appearance when elicited on the back, the sitting position or upright posture, so incongruous to their original (prone) motor expressive origin.

Over and above all somatic reflex response is the Tonic Neck Reflex (when properly elicited) ready to control, correlate and integrate all important lower cord levels and bring them into a full homolateral amphibian pattern. If the midbrain is intact, movement smooths out and "graduates" almost automatically into the diagonal "crossed" pattern of the reptile.

This sequence occurs in the normal child as well as the spastic. Movements up to the level of infant crawling are available by reflex activity in the cortical spastic. How these reflexes may be used and integrated with the more complicated patterns of the mammal and the upright posture of man must be worked out in each patient problem. Suffice it to say, that *feeding*, *walking* and certain *self-care* responses are available through "conditioning" even for the profoundly involved cases, when reflex patterns are used as the base for activating otherwise paralyzed and spastic musculature.

"Unlocking" reflexes may be considered as that phase of the progression cycle prior to the expression of a movement pattern. A relaxation or modification of the antagonist group, particularly in the prime muscles, normally occurs, so that power expression can move smoothly in the contracting group. This is a balanced reciprocal process of reflex nature.

The pattern of movement to bring an extremity into position to express a forceful projection response, is filled with a series of "unlocking" phases as the necessary muscles for the next cycle reciprocally relax. This is accomplished by a serialized feed back (cybernetic) proprioceptive mechanism, with the dominant *power tone* always in the projectional (human flexor) groups.

As is well known, during the flexor expressive phase the extensors are relaxed, and vice versa.

In searching for these points of "relaxation" in both the "flexor" and "extensor" cycle of muscle response, it became evident that in the amphibian-reptile patterns certain points are identifiable as critical in the cycle of the progression act.

In the human species because of changed posture, attitude and functional adaptation of the parts, "unlocking" reflexes are less obvious; but none the less present and very important, in correctional therapy and modification of a spastic part, or posture (reported in detail elsewhere).[4]

[4]Trans. Am. Neurol. Assoc., 1953, practical manual in preparation.

From the practical standpoint of treatment, which is our immediate concern, the following "unlocking" reflexes and positions will be found of great assistance to the physical therapist in the spastic groups for the establishment of relaxation and better function of muscles and rehabilitation of the part.

The *spastic hand* may best be "unlocked" with the patient in the prone position, face turned to the opposite shoulder, the back of hand resting on, or just above, the buttocks of the same side. The tightly closed "fist"-like hand can be easily forced open in this position. An *opening, or fanning of the fingers*, is best accomplished with the hand in the above position, the thumb moved to the *opposable* position across the palm from the middle finger and with the *proximal* phalanx *adducted*, while the *distal* phalanges are *extended* in full abduction.

With the hand open, palm up, passive manipulation of the fingers and wrist for several minutes brings about joint and position sense awareness at the parietal cortex level (if intact) and may arouse a "body image" consciousness of the part long since lost to sensory-motor-memory. It is following this procedure and with the fingers and thumb opposable that slight but definite voluntary flexion movements may appear for the first time in an otherwise long paralyzed spastic hand.

The patient frequently cannot reproduce the movement at will and appears to "search" for the means which caused its appearance as though the cortex had "lost" contact with the center.

Paradoxically enough, the *greater the effort* on the part of the patient the less finger response, whereas, to simulate *lightly touching* the thumb to the middle finger brings better response.

With the hand in the palm up, over the buttocks position, and with the aid of double mirrors, so that the patient can view his efforts, weak and almost obliterated movements of the fingers can often be aroused and ultimately trained into strong, purposeful flexion responses, important in feeding. "Flexion" patterns appear before "extension" responses and the patient is usually *unable* to "open" the hand to the command. Slow extensor responses are present, however, when instructed to "stop" the flexor effort.

This paradox must be accepted and developed by repetitive training, so that the command of "stop" becomes the basis for the function "open", and after visual confirmation by the patient through the properly adjusted mirrors, the function of opening of the fingers can be learned, and the relaxation component ultimately "captured" by higher cortical controls for voluntary uses.

The *spastic flexed arm* may be "unlocked" into a full extended position, by the simple maneuver of elevating the elbow to the level of the shoulder cap (patient in prone position, face turned *toward* the hand, thumb at the teeth level), and then drawing the hand and wrist downward, outward, and backward, rotating the humerus 30° with the elbow-tip at the shoulder level, until the hand has passed beyond the mid-perpendicular point of lateral sweep.

At this point and throughout the ensuing arc of 45°, the forearm will be found to easily relax and extend, especially as the hand begins to assume the palm-up position on its way to complete the cycle over the adjacent buttocks.

For those that would study the sequence in detail, it is recommended that

they either purchase a small turtle, or observe one in the act of moving the anterior extremities in a progression pattern.

To "unlock" spastic lower extremities (diplegic, hemiplegic or paraplegic), the patient can be made to respond while on the back (supine), but the full movement patterns are best obtained when on the abdomen, with a 4-inch pad support under the symphysis (abdomen and hips slightly elevated above the table surface).

Spastic adductors may be temporarily relaxed by the "Marie-Foix" reflex, in 5 to 10 minutes of repeated application. Clonus, Babinski, and other reflexes may be employed for relaxation of the foot and toes.

When the patient is supine, the leg must be rotated outward (femur) so that the knee cap is approximately 30° lateral to the vertical plane. If the patient is prone, the legs are arranged so that the knees and the big toes point outward (frog position). Where spasticity is too great to permit this position, the therapist may bend the toes downward, and press in on the ball of the foot (Marie-Foix). The leg will immediately flex at the knee (withdrawal) and the *adductors* will relax after several attempts. The position may then be established in the prone position to carry out further exercises.

Returning to the more convenient "supine position" with the toe-knee cap pointing outward 30°, one hand is placed with the palm above the knee, fingers over the hamstring tendons, and the other hand with the palm over the dorsum of the foot, fingers curved over the toes and the tips against the padded ball of the foot.

By a movement of the therapist's wrist and fingers that bends the patient's toes downward, at the same time pressing in on the ball of the foot, the spastic leg will draw up reflexly, being now guided outward as far as possible by the hand at the knee level. When in full flexion, the knee is then pushed into the midline, followed by downward pressure on the leg from above. It will be noted that with this maneuver a complete cycle of the "walking pattern" has been effected. If the therapist should care to make it entirely automatic, and with the least amount of effort expended on the procedure, a tap of the patellar tendon, after the knee has flexed to the Marie-Foix stimuli, a purely robot simulation of "stepping" can be accomplished, and as will be noted, relaxation of the patient's adductors ensues. Reduction in the spasticity for the benefit of later "patterns of movement" and crawling in the prone position is thus accomplished.

Considerable "unlocking" of the pelvic structures may be obtained with the Riddoch's Mass reflex in the prone position, and trunkal relaxation can be encouraged by the repetitive use of the full amphibian (homolateral) and reptilian (crossed diagonal) "patterns of movement" that precede the normal crawling stage. In patients with fixed or tilted pelvis, a better gait is established by these trunkal patterns and shoe lift corrections have been improved in some chronic cases.

SUMMARY

It is now possible to "unlock" and relax certain spastic muscle groups by the use of intrinsic reflex spinal cord mechanisms. The benefits to posture, muscle tone

and functional activity depend upon training and utilization of the improved state of spasticity and muscle response and through appropriate measures of physical therapy and "patterns of movement" which will lead to better rehabilitational accomplishments.

It is high time that we began to put certain "normal" and so-called "pathological" reflexes to work for the benefit of the patient, and not merely record them as curiosities of neurological response.