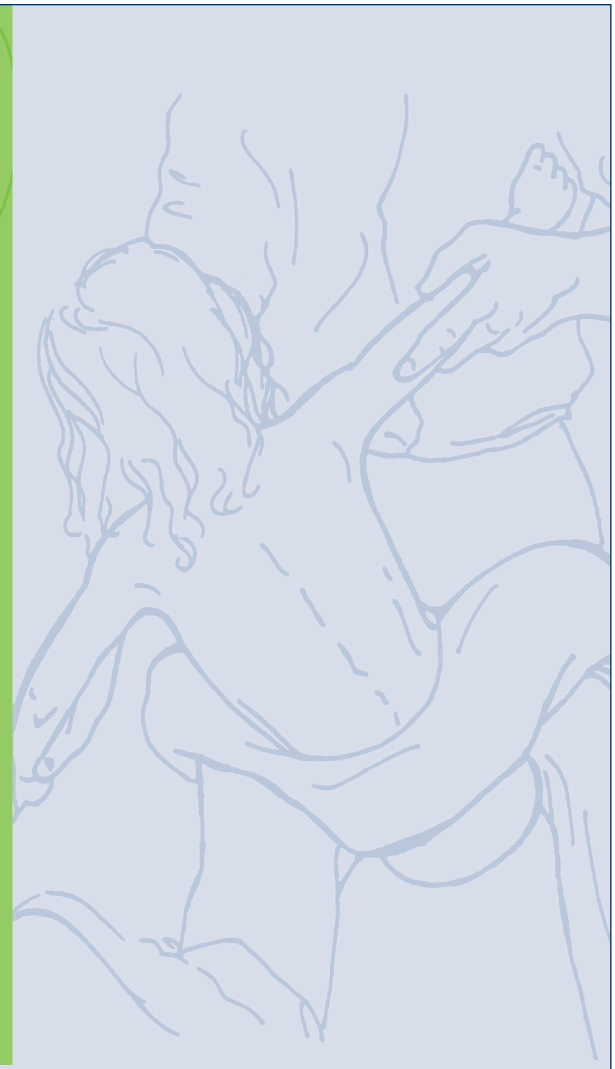
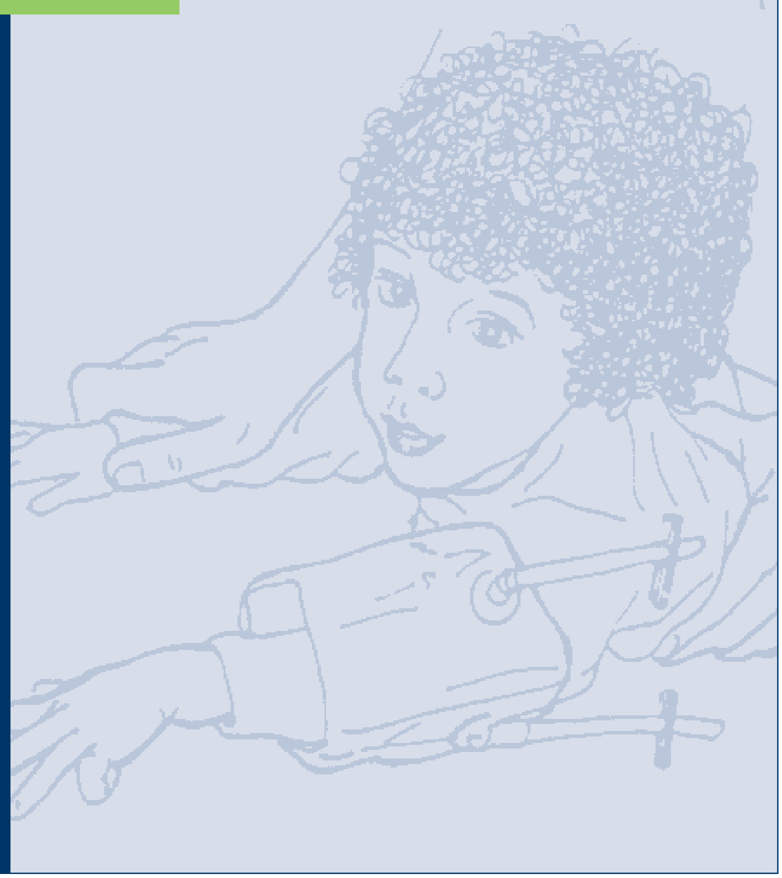
clinician's view

Somatic Adaptation in Cerebral Palsy





LINKING ASSESSMENT WITH TREATMENT: AN NDT PERSPECTIVE

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INTRODUCTION

Somatic adaptation is one of the primary functions of the central nervous system. It refers to the need for the body to adjust and maintain itself in a gravity environment thus allowing controlled motor activity. Children with cerebral palsy suffer from an altered state of somatic adaptation. Neurological damage which affects the function and physiology of muscles and joints interfere with normal adaptation of the body in relation to gravity and movement. Facilitating somatic adaptation is therefore a primary goal of treatment for children with cerebral palsy.

Cerebral palsy, as a primarily somatic disorder of movement and posture, has characteristics which are determined by the extent and location of brain damage. Types of cerebral palsy include spasticity, athetosis, low tone, ataxia or a mixed form of several characteristics.

Various physical handling techniques are required to increase, decrease or stabilize postural tone, therefore preparing the child for activities to improve somatic competencies in movement and posture.

Physical handling includes both facilitation and inhibition. Facilitation means to assist or make easier. It implies assistance or aid to normal function. Inhibition means to restrain or prohibit. It implies the restraint or repression of abnormal function. Choosing what to facilitate and/or inhibit, requires the therapist to answer six basic questions.

1) What is normal?
2) What is abnormal?
3) What do I want to change?
4) How will that change look and feel?
5) What techniques will I choose to attempt to make a change?
6) Was the attempt successful? Why?

The answer to each of these evaluative questions will lead the therapist continually through the treatment process insuring progressive and creative treatment strategies.

The basic goal of treatment is to establish and normalize, what Bobath[2] has described as the postural reflex mechanism. The PRM includes normal postural tone, reciprocal innervation and equilibrium and righting reactions. The PRM allows normal movement and function to take place. Resting and active muscle tension throughout the body cooperate through various agonist and antagonist relationships to provide the postural background for the maintenance of balance and dynamic movement through space.

Patterns of movement can be described as anti-gravity and pro-gravity[S] Anti-gravity responses, such as antigravity flexion in supine or extension in prone, describe the movement of postural reactions away from the supporting surface. Pro-gravity responses can be considered as movements toward the surface or into gravity, such as flexion toward the surface from standing or extension into the surface seen in bridging and early rolling.

Anti-gravity movement requires strength against the resistance of gravity while pro-gravity movement requires strength in holding and grading release against the pull of gravity. Anti-gravity and pro-gravity interdependence results in a controlled balance between flexion and extension, essential for organized and coordinated movement.

Development may be viewed as a series of critical competencies. Anti-gravity competency in supine flexion and prone extension provide the postural basis for upright control and mobility.

Critical competencies in development may be analyzed with criteria-based referencing of typically normal responses. Various anomalies resulting from somatic mal-adaptive motor behaviors can then be related to various types of cerebral palsy. Abnormal motor patterns can only be fully appreciated and assessed through a complete knowledge of normal motor development and the resulting somatic adaptation necessary for function.

Linking assessment with treatment is the most important principle of any intervention program. Linkage requires an understanding of the relationship between the functional importance of normal critical competencies and learning behaviors,

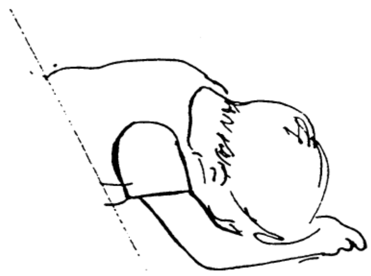


Figure 2b Upper extremity flexor spasticity in prone.

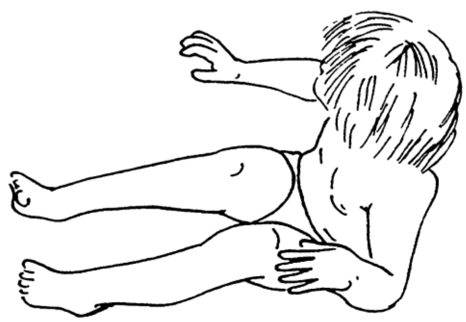


Figure 2b Lower extremeity flexor spsticity in sitting.

Athetosis is a term used to describe children with fluctuating tone. This type of postural tone has a great degree of variability from very high to very low or anywhere in between.

Children with athetosis are in constant motion, particularly when involved in volitional activities. These children are not as much at risk for contractures or joint deformity as spastic children, because they are not bound to one position and do not have constant stress on a joint or muscle group as in spasticity.

Behaviorally, these children are also often quite different. Athetoid children appear more outgoing, more apt to take risks and more explorative of their environment with wide mood swings. The behavioral tone of these children is surprisingly quite like their postural tone.

Athetoid children usually suffer from laxity in joint movement, with hyperextension present in the digits and knees particularly, due to the constant fluctuation of tone and extreme ranges of movement. In some cases there are extensor spasms resulting in a dystonic, or tension type of athetosis, causing a stiff extreme pattern of internal rotation, extension and adduction of a limb, often related to tonic reflexes. Most athetoids, however, have low underlying postural tone, superimposed with extremes. They are usually long and lanky, perhaps because of joint laxity and a lack of joint stability. Many children with athetosis also have mixed tone, or a combination of athetoid characteristics and degrees of spasticity.

Figure 2 Athetoid with influence of ATNR and underlying low tone.

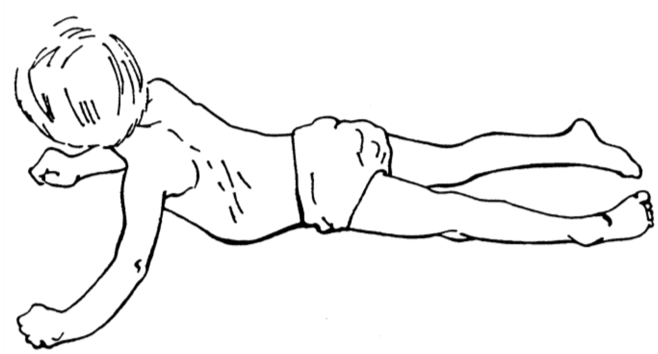


Figure 3 Athetoid with upper extremity tightness and corresponding extensor spasm of lower extremities; STNR influence.

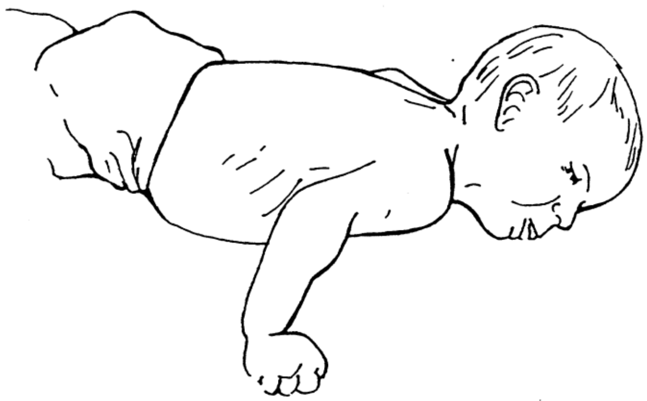


Figure 4 Athetoid with mixed spastic tone evident in shoulders and hands.

Low tone or flaccid children suffer from an extreme lack of muscle tension and a resulting lack of muscle mass. They have very poor muscle strength and are seen as extremely flat when placed on a surface. They usually exhibit a passive pattern of flexion, abduction and external rotation. They usually prefer the supine position and often push into gravity in an attempt to move. Low tone children, however, do develop tone over time, and it is not uncommon for some low tone infants to develop athetoid or spastic postural tone.

Figure 5 Low tone child showing extreme bridging into gravity in an attempt to move.

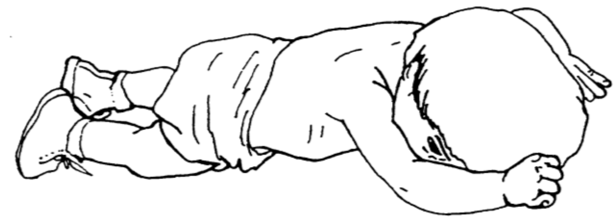


Figure 6 Low tone child unable to initiate any extension against gravity.

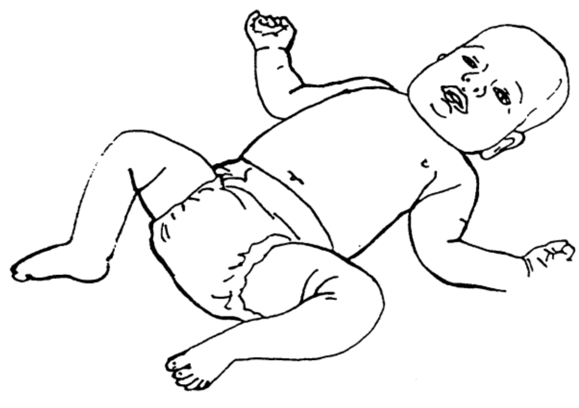


Figure 7 Low tone resting position in supine.

Table 6 Important Aspects Of Prone Development

PRONE COMPETENCIES
Anti-gravity flexion
Pro-gravity extension

FUNCTIONAL ASPECTS
Horizontal-vertical visual control
Bilateral distal control
Competition of patterns
Proximal control and strengths
Trunk stability for distal function

MOTOR BEHAVIORS
The child will:
Lift head and maintain reach with chest off surface
Reach with lateral flexion
Push up with arms and legs
Maintain full hip extension

Adaptive Behaviors In Prone Development

The prone posture provides the infant with the experience of head movement against gravity and constant visual localization and re-localization in horizontal and vertical planes. The initial visual localization of objects in space helps in directed eye-hand activity later, when the infant can prop and support his upper body while simultaneously using a limb and hand.

Weight bearing is a significant experience in prone. First, physiological flexion (See Fig. 19) of the neonate pushes the body weight forward on to the head/neck region. This distribution of weight helps to compress the cervical spine and develop postural neck co-contraction. Turning of the head results from a survival response to clear the nasal pathway and functionally; it effectively stimulates increased tension in the cervical spine. As the infant gradually extends his trunk and hips, the distribution of weight directly on the cervical spine diminishes, thus allowing more and prolonged lifting and stabilization of the head and neck against gravity. (See Fig.20) As the trunk itself provides more extensor "power," the thorax is able to develop pro-gravity flexion to assist protraction of the shoulders and forearm support. (See Fig.21) Thoracic control is important for midline orientation; and to balance trunk extension for lateral excursion of the limbs. (See Fig.22) Unopposed extension without thoracic flexion can be normally seen in the extreme airplane response of the 4 month old. (See Fig.23) This extreme extensor response is normally present, although not prolonged or excessively used by the normal infant. It is a good example of two fundamental developmental principles. First, the normal nervous system prepares itself sensorially through extreme motor ranges for a threshold tolerance beyond the need of routine movement. Secondly, the functional importance of movement rests in the intricate balance of flexion and extension in any posture and the harmony of "power" and "hold" is essential for transitional movements into, (pro) and away from (anti) gravity.

As the child continues to develop a balance between flexion and extension in prone, he is able to initiate competitive patterns. Competition of patterns refers to the ability of the child to dissociate his body into different complimentary patterns of flexion and extension. This is seen in the ability of the child to flex and hold in a pro-gravity response to the surface on one side of the body, while the other side moves away (anti) from grayiry to explore or reach out with an arm and hand in lateral flexion of the trunk, supported by weight shift. (See Fig.24) Unilateral and bilateral dissociation of the distal musculature is available with an integrated competition of movement patterns, and eventually allows for total upper and lower body competition of flexion and extension required for crawling, and four-point control.

Figure 18 Forward weight bearing and compression of cervical spine in early days after birth.

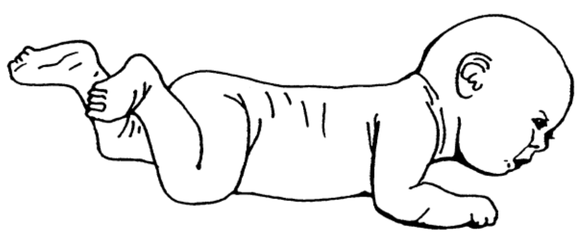


Figure 19 Prolonged lifting of the head after initial development of cervical control.

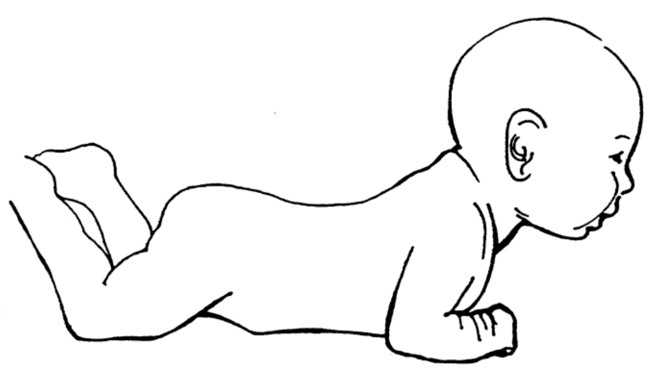


Figure 20 Prone propping with free and stable control of head.

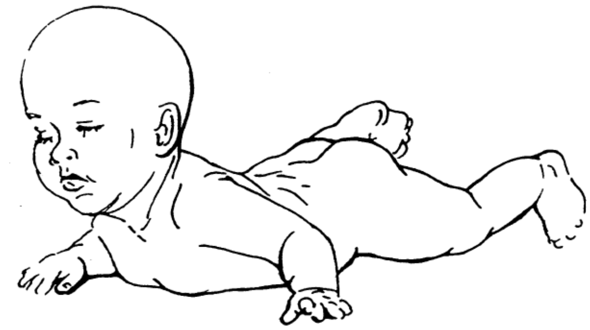


Figure 21 Controlled extension with thoracic support allowing for free arm excursion.

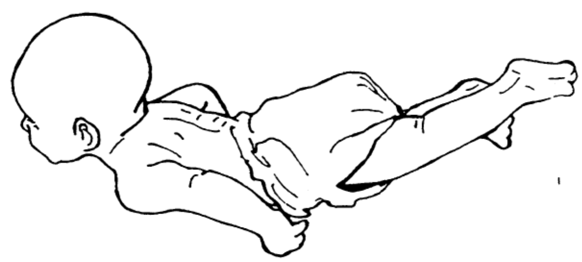


Figure 22 Extreme normal extension without thoracic flexion.

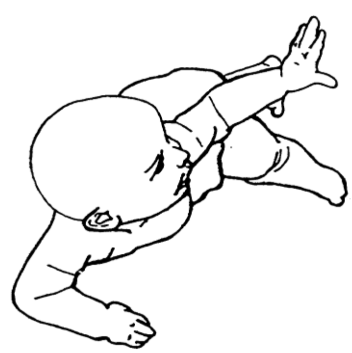


Figure 23 Dissociative control of weight shift, elongation, flexion and extension.

Table 7 Important Developmental Aspects Of Mobility

MOBILITY AND UPRIGHT COMPETENCIES
Integrated competition of patterns
Balance of pro & anti-gravity control

FUNCTIONAL ASPECTS
Upright stability
Dynamic equilibrium
Transitional graded control
Controlled verticality of head/trunk
Visual control of movement

MOTOR BEHAVIORS
The child will:
Roll side to side/prone to supine
Sit rotate and reach
Side sit and rotate to crawl
Pull to stand and cruise
Stand and walk/one hand held
Stand and walk independently

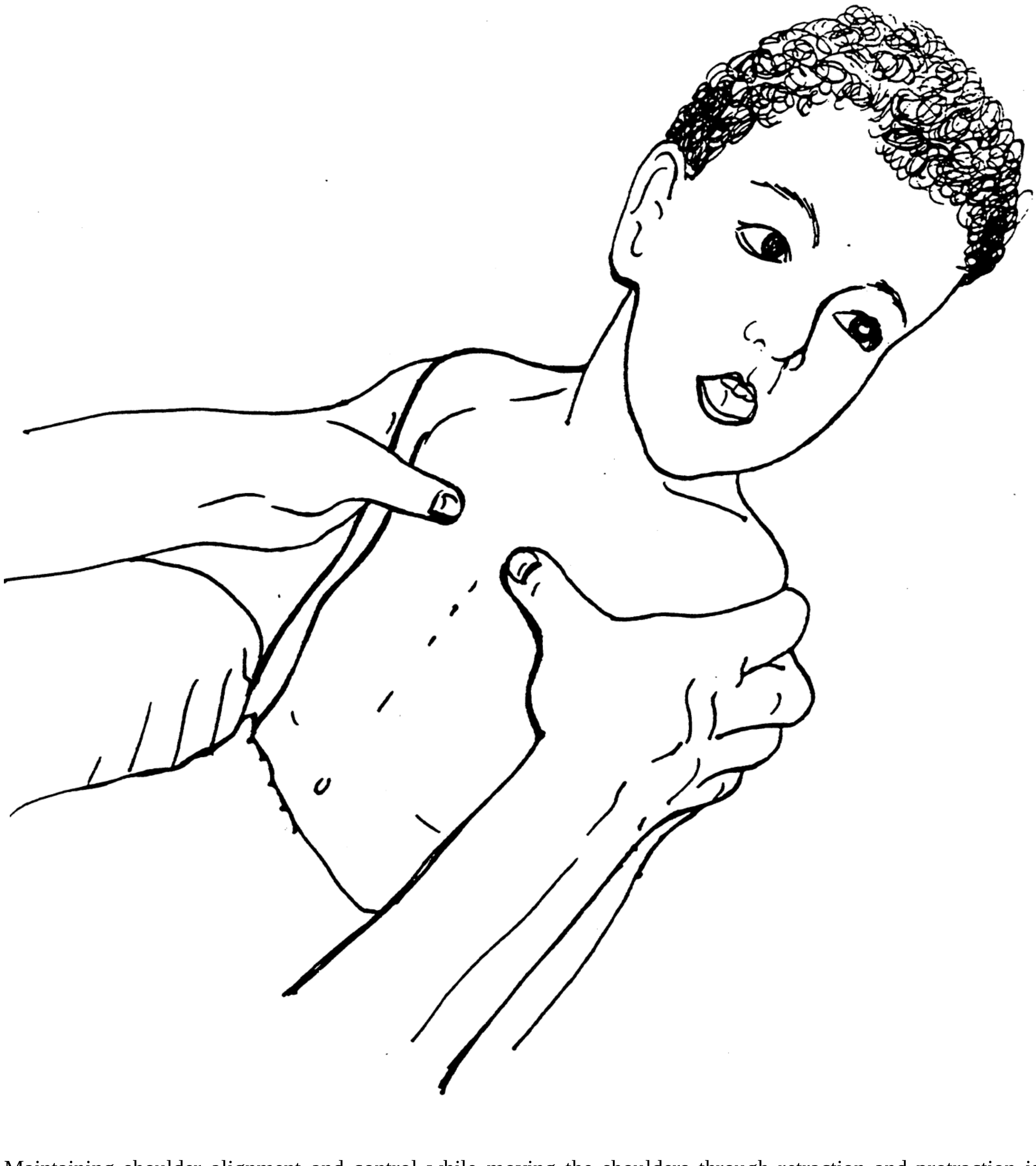
Adaptive Behaviors In Mobility Development

The development of mobility is a consequence of the establishment of anti-gravity flexor and extensor control, balanced by pro-gravity flexor and extensor holding. Mobility, starting with the ability to assume four-point and eventually upright postures require graded transitions from one postural set to another. Transitional components are characterized by active rotation. Rotational components in movement help activate and modify extensor and flexor responses. Rotation employs the use of flexor holding (pro-gravity) in movements requiring extension to upright postures. Conversely, rotation employs extensor holding for transitions returning to postures which move from total upright control to postures closer to gravity, such as moving from standing to prone through temporary postures of side-sit and four-point. Ultimately the toddler is able to move into and out of gravity from supine to standing and standing to prone in symmetry, however, during the first several years, the rotational components of movement are required to grade the smooth responses from posture to posture. Upright postural freedom is developed through the progressive control and building of postural tone, control of weight distribution through shifts made possible by competitive patterns of flexion and extension, and the refinement of rotational components responsible for grading anti and pro-gravity cooperation. It results in the ability of the child to develop and excel in equilibrium reactions for dynamic mobility in standing, walking and running. (Fig's 25-34)

Figure 44

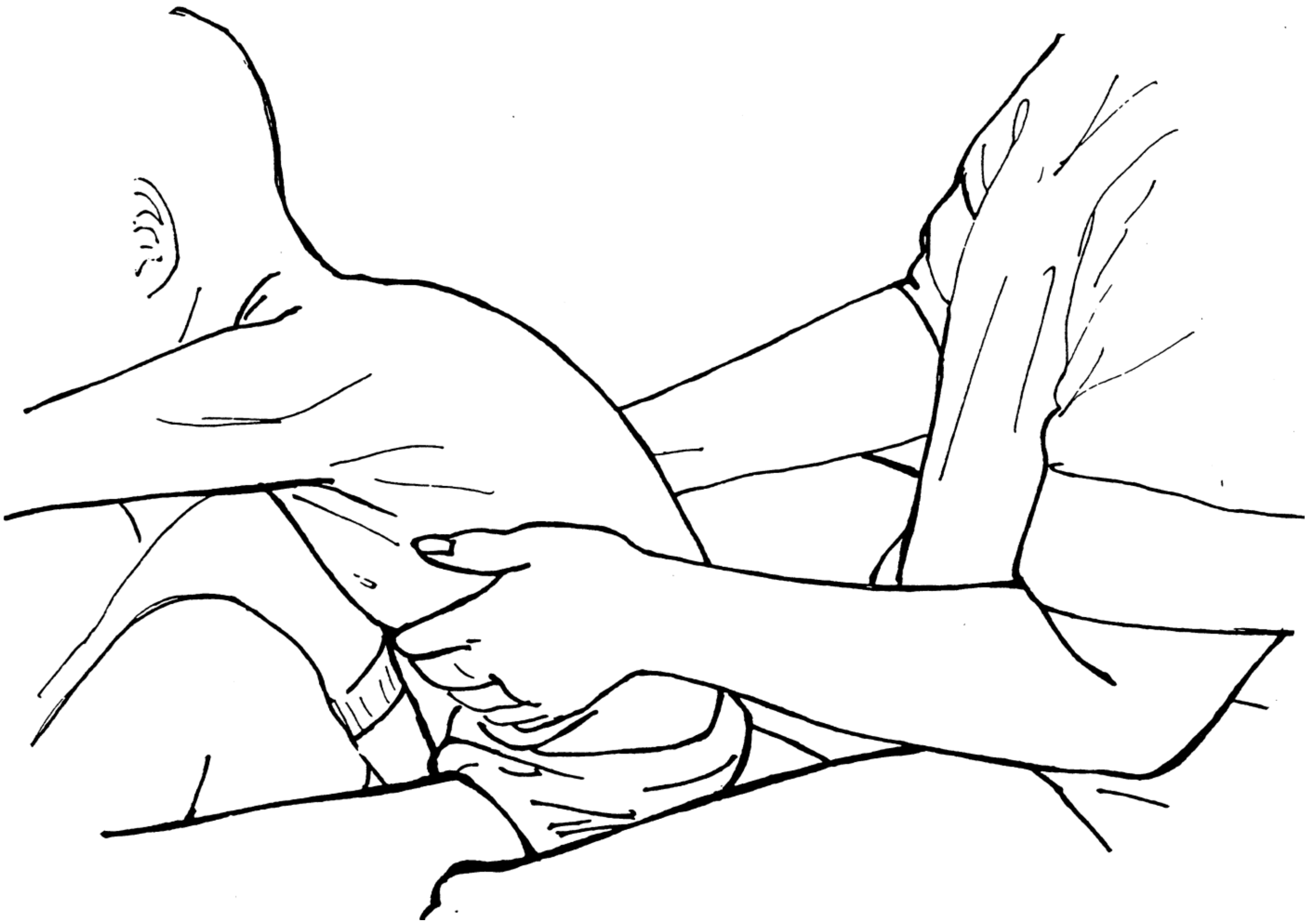
Slowly lifting the head away from the surface while controlling the shoulders allows the child to experience dissociation of the head from the body. In spastic child sustaining the elevation with slight traction helps to maintain tone reduction and establish better sensory tolerance. Low tone children require gentle intermittent support to help build neck tone and stability, while athetoid children benefit from sustained holding to increase sensory tolerance for stability and to inhibit fluctuations.

Figure 45



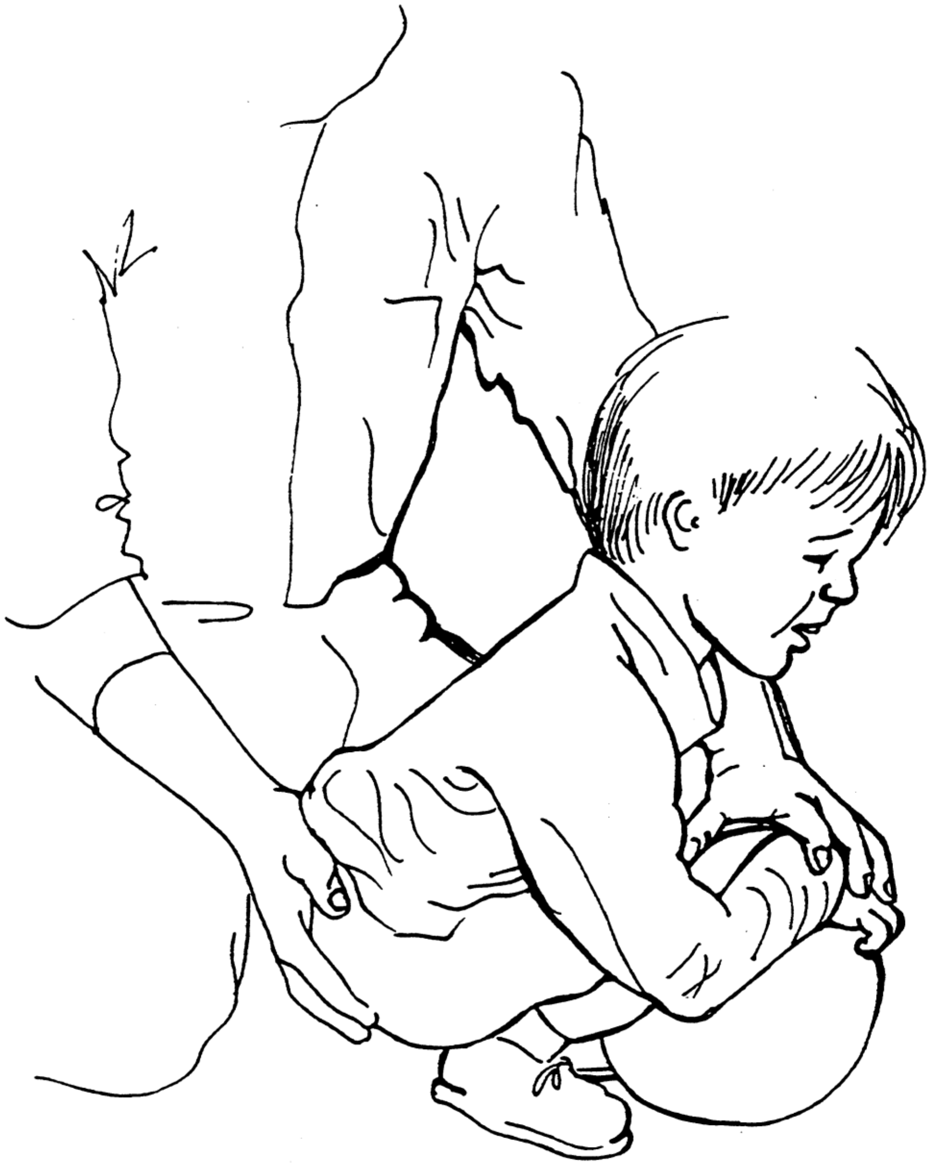
Maintaining shoulder alignment and control while moving the shoulders through retraction and protraction is helpful for sustaining inhibition of spasticity during movement. Slower, more deliberate excursions with pressure can assist the athetoid child to experience graded movement while inhibiting fluctuation. Tone can be increased in low tone children by adding firm approximation toward the midline.

Figure 69



Placing the child on the handler's lap and promoting forward flexion allows the lumbar spine to elongate and decrease tension in tile low back through natural traction from the positioning of the upper trunk in flexion. Movement of the tissues over the rib cage frees the respiration. Controlling the trunk on the surface with firm pressure also assists in decreasing flexor spasticity below the ribs. At the same time displacing the trunk laterally assists in dissociating the lower trunk from the pelvis, shifts the body weight laterally and mobilizes the pelvis in lateral tilts. Spastic children with tendency for flexor spasticity of the arms may need additional control of gaiter splints to maintain arm extension and encourage free arm movement during lateral shifting of the trunk.

Figure 70



Weight bearing can be added to a total body flexor pattern by placing the child in a squat position in front of a small ball. Supporting the pelvis and the arms allows the handler to shift the child's weight forward and back over the feet. This compressed posture is advantageous for low tone and athetoid children. Spastic children with strong flexor spasticity benefit only if their spasticity has been reduced and good postural tone can be maintained.

Figure 71

Kneel standing with proprioceptive upper extremity weight bearing may be accomplished by maintaining leg alignment with the handler's knees and supporting the trunk and hand placement on a roll. The child's weight can be shifted forward and back to influence sustained holding and postural support of the upper extremities. Spastic children may need continual gentle shifting to inhibit spastic reactions, while athetoid children can tolerate more movement with care to control fluctuating tone. Low tone children may need more upper trunk support, occasional tapping of the abdominals and intermittent placing or dropping of the arms to maintain increased tone in the upper extremities and trunk.

Figure 72

Straddling a roll and controlling the shoulders while maintaining hand contact with the surface allows for upper extremity proprioceptive weight bearing. Gentle elevation and depression of the shoulders can be effective in reducing shoulder spasticity. Compression into the shoulders increases joint awareness and stability for athetoid and low tone children and allows the handler to maintain midline control while shifting the child's weight over the hands to increase proprioceptive upper extremity support.