

Persistent Primitive Reflexes: A Prognostic Study on School-aged Children with Intellectual Disability

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Introduction

A human baby comes into the world with a number of primitive reflexes which contribute in various ways to its birth, survival and subsequent development. At birth a baby has no control over voluntary movement and responds to the environmental stimuli through the primitive reflexes. They also provide the training ground for the many aspects of latter functioning.

As the infant begins to grow and mature during the first six months of life, the Central Nervous System also begins to mature. Higher and more sophisticated regions of the brain begin to supercede the primitive reflexes. As this occurs, early survival patterns are inhibited or allow to more mature patterns of response, postural reflexes, to develop in their place. It is only as postural reflexes replace primitive reflexes that an infant begins to gain control of the body and body movements.

Some children fail to gain full control in the first six months of their life and continue to grow up in the reflexive where some of the primitive reflexes remain present and the postural reflexes do not develop fully.

If primitive and postural reflexes do not mature at the correct developmental stage, they are said to be aberrant. Aberrant reflexes can result in immature motor development despite the acquisition of later developmental skills. When a cluster of abnormal persist, neuro-developmental delay is said to be present. (Goddard, Blythe, S., 1996)

Knowledge of the abilities of the newborn, and of his primitive reflexes, is important not only for the understanding of human development as a whole but also for research into it application for the overall assessment of a baby, for recognition of possible neurological damage in the prenatal and perinatal period, and for the establishment of prognosis for their future.(Illingworth, R., S.,1994)

To understand what goes wrong when the reflex aberrant, it is important to realize which job individual reflexes perform at the time that their present is normal.

Literature Review

1. Reflexes

A reflex is an involuntary response to a sensory stimulus. Certain sensations or movement are known to produce specific muscular response. The presence and strength of a reflex is an important indication of neurological development and function.

The reflexes are substrate of human; they are raw material on which the central nervous system builds volitional movement. (Easton T,A., 1972)

2. Primitive Reflexes

The Primitive Reflexes are automatic, stereotyped, rhythmical movement directed by the brain stem and carried out without involvement of the cortex of the brain. They emerge in utero, are present at birth, and should be inhibited by six months of age —twelve months at the latest.

3. From Primitive Reflex to Postural Reflex

The transition from primitive reflex reaction to postural control is not an automatic one. There is no set times at which the later reflex asserts control over the earlier one, but it is a gradual process of interplay and interaction during which both reflexes operate together for a short period of time.

Fiorentino (1981) linked the primitive and postural reflexes to three stage in the development of mobility — **apedal** , **quadruped** and **bipedal** ; each one signifying a new stage in the recapitulation of our evolutionary heritage and active involvement of higher system of the brain.

3. **Bipedal** – Initiate at the cortical level involving many other centers including the basal ganglia and the cerebellum . Equilibrium develop when muscle tone is normal to facilitate body adaptation in response to change of gravity

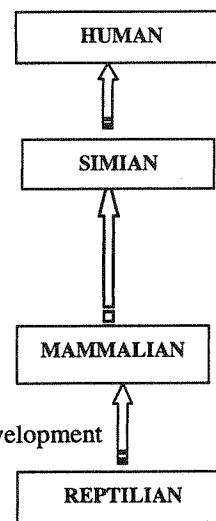
OcculoHead Righting reflex (OHRR),
Landau Reflex ,
Symmetrical Tonic Neck Reflex

2. **Quadruped** – Predominance of midbrain development with righting reaction motor development is at the level of the who can turnover and assume crawling and sitting position

Labyrinthine Head Right Reflex (LHRR), Neck Right reflex,
Segmental rolling Reflex, Parachute response
Symmetrical Tonic Neck Reflex, Landau Reflex

1. **Apedal** — Predominance of primitive spinal and brainstem reflexes motor development is at the level of prone and supine lying creature.

Moro reflex, Tonic Labyrinthine Reflex, Asymmetrical Tonic Neck Reflex
Rooting and Suck Reflex, Palmar Reflex, Spinal Galant Reflex



4. Primitive Reflexes; chronology & symptoms

Many scientists and researchers had found that the effect of retained or persistence of Primitive Reflex on impairment, limitation of function, and disability and these finding were also well documented by the authors listed below.

Ayres (1979,1982) Bein-Wierzbinski (2001) Bobath and Bobath (1955) , Capute(1981) DeMyer (1980) , Holt (1991), Gazzaniga (1973) , Gesell (1947) , Blythe (1992) , Goddard (1989, 90, 91) Miriam Bender (1976) , O,Dell and (1996) Rosanne Kermoian (1988) , Veras (1975)

A. Asymmetrical Tonic Reflexes (ATNR)

Chronology:

Emerges at around 18 weeks in utero and is inhibited or suppressed between 6–8 months after birth, while awake. It persists till three and a half years while asleep.

Role and Description:

The ATNR fulfill many purposes. It has been suggested that one of the primary function is to assist in the birth process- the rotation of the head allows the shoulder to move, and therefore the baby moves in a spiral down the birth canal.

ATNR may also help survival. When the baby is placed prone, it should not go into the “frog” position. The head should go to one side, with extension of the jaw arm and leg. This allows free passage of air. ATNR is the first training ground for hand-eye coordination.

Activation:

Head rotation to either side.

Reaction:

The jaw arm would extend slowly, the jaw hand and fingers would also extend. The jaw leg would extend, but not much as the arm.

The occipital arm and leg would bend. [It is the ‘kick’ the mother feels, and it should get stronger and stronger as birth approaches.]

Symptoms Suggestive of Residual or Retained ATNR**Symptoms:**

1. Balance may be affected as a result of head movement to the other side
2. Homolateral (one side), instead of normal cross-pattern movements
3. Difficulty crossing the midline
4. Poor ocular “pursuit” movements, especially at the midline. (Catching a ball will be affected)
5. Mixed laterality. (Child may use left or right hand interchangeably for the same task.)
6. Poor hand writing and poor expression of ideas on paper
7. Visual-perceptual difficulties

Motor-functional Analysis of ATNR

Motor-functional analysis also disclosed that ATNR can be interpreted as a physical condition in which the whole body is longitudinally separated into two parts: left and right side. This is also a condition where one side of the body is totally extended and the other is flexed.

In ATNR, at the side where the face of the child turns hypertonicity of the extensor of the neck, trunk, upper and lower extremity is concomitantly predominant. So hypertonic extensor of the neck, trunk, upper extremity and lower extremity in the same side work together simultaneously and cannot move separately because of their immaturity in movement. It could be deduced that ATNR is a manifestation of primitive locomotion, where the body is divided into two parts, which work alternately to drive the body forwards.

B. Symmetrical Tonic Neck Reflex (STNR)

Chronology: This emerges around the 9-10 months after birth and is inhibited or suppressed at about one year.

Role & Description: STNR is concern with the alteration of the limbs muscle tone according to the change of position of the head relation to the trunk. It has very short significant life. After the baby, ideally in development, has crawled on his stomach, around 9-10 months the developing brain releases the reflex to allowing the baby to start defying gravity.

Activation by: From a kneeling position, either movement of the child’s head upward or downward.

Reaction: In kneeling position, flexion of the head causes the arms to bend and the legs to extend. Head extension, on the other hand, causes the legs to flex and the arms to straighten

The sole task of the STNR is to get the child to defy gravity by getting up off of the floor onto hands and knees from the prone position. The transition up into a crawling position is assisted by the emergence of the “STNR” which enable extension of the arms and flexion of the legs at the same time.

Symptoms Suggestive of a Residual or Retained of STNR

1. Poor posture
2. Tendency to “slump” when sitting, particularly at a desk or table
3. Simian (ape like) walk
4. “W” leg position when sitting on the floor
5. Poor eye-hand coordination
 - a. Messy eater
 - b. “Clumsy child” syndrome
6. Difficulty readjustment of binocular vision
7. Slowness at copying tasks
8. Poor swimming skill

Motor-functional analysis of STNR

In this mode of locomotion, the body propels itself with symmetrical extension of the upper trunk and upper extremities, while lower trunk and extremities symmetrically flex. Then, lower trunk and extremities symmetrically extend, while the upper extremities symmetrically flex, driving the body forwards. In this locomotion the driving phases in upper or lower extremities can be seen alternately in all phases of locomotion. Phylogenetically, original form of STNR is mostly seen in propulsive movements such as swimming of the frog, and symmetrical quadrupedal locomotion of the Kangaroo. In the human body, we can see this form in breaststroke swimming and a vaulting horse activity. These are symmetrical locomotion patterns in which a phase of upper body flexion and lower body extension and upper body extension and lower body flexion emerge alternately, and propel body forwards.

Tonic Labyrinthine Reflex (TLR)

The reflex is activated in the labyrinthine which indicates changes of location in space to the brain.

TLR has two phases;

The first phases; in flexion, emerge before the 12th week (3 months) after conception. Inhibited by baby by 4 months old. The flexion phase is evident as the baby’s head is moved toward chest; the baby will curl up into fetal position.

The second phase; in extension, is present at birth and is inhibited slowly usually in the first 3 years depending on the development of other reflexes. The extension phase can be seen when a baby’s head is tipped backwards and the baby will extend his arms and legs.

Symptoms Suggestive of a Residual or Retained of TLR

Reflex In Forwards (Flexion)

1. Poor Posture – stoop.
2. Hypotonus – weak muscle tone.
3. Vestibular related problems.
4. Poor sense of balance.
5. Propensity to get car sick.
6. Dislike of Sporting Activities,
- Physical Education class, running , etc

Reflex in Backward (Extension)

1. Poor posture – tendency to walk on toes.
2. Poor balance and coordination.
3. Hypertonus – stiff, jerky movement because the extensor muscle exert greater influence than the flexor muscles.
4. Vestibular related problems.
- Poor sense of balance.
- Tendency to motion sickness.

7. Oculomotor Dysfunctions.
8. Visual-perceptual difficulty.
9. Spatial problems.
10. Poor sequencing skill.
11. Poor sense of time.

5. Oculomotor dysfunction.
6. Spatial perceptual problem.
7. Poor sequencing skill.
8. Poor organization skill.

Motor-functional analysis of TLR

TLR , extension phase;

The extension phase in Tonic Labyrinthine Reflex in supine is fundamentally considered to be a form of primitive locomotion. Baby below 3 months move themselves forward, by kicking their leg, with extension movement of the trunk and extremities in supine position. This is a primitive locomotion, using flexion-extension pattern of the tonic labyrinthine reflex. Starting jump in supine position in backstroke in swimming is also a primitive and most propulsive locomotion without any gravity support. Thus, extension pattern of the TLR could be observed in primitive movement in cerebral palsied patient, human baby and even in adult , then , therefore can be designated as a movement.

Flexor phase, prone position

Flexor pattern in TLR can also been seen in various phase of human posture and in locomotion. In a normal human body, when they need highly propulsive movement such as running or jumping, crouched flexed posture emerges. This can be interpreted as a sudden emerge of flexed position of the tonic labyrinthine reflex. Antigravity extensors are facilitated during growth, which overcome flexor hyperactivity in TLR resulting in antigravity such as kneeling and standing.

5. The Impact of Primitive Reflexes on Education

Gustafson (1970), Rider (1972), Bender (1976), Wilkinson (1994), O'Dell and Cook (1997), examined the effect Primitive Reflexes have on education, The results indicated that abnormal primitive reflexes were a contributory factor in learning difficulty, writing problems, Attention Deficit Disorder (ADD) and Attention Deficit Hyperactive Disorder (ADHD), and underachievement.

It is also recognized that aberrant reflexes can affect higher cortical functioning particularly in the area of education (Ayres 1972/3, Bender 1976, Blythe McGlown 1979)

The effects of retained primitive reflexes and underdeveloped postural reflexes in the older children are also well documented (Bobath & Bobath 1965, Ayres 1972/3, Fiorentino 1981, Levitt 1984).

The role of abnormal reflexes in mental retardation as a discreet entity has never been established despite that mental retardation is sometimes categorized as a developmental and neurological disorder. In view of the evidence, it was decided to investigate how primitive reflexes persist and relate to impairments and functional limitations.

Aim

It was an attempt to reveal persistence of primitive reflexes and how they predict impairments and functional limitations among the children with intellectual disability.

Method

72 children were selected from a wider group of children who were attending at one of the special schools of Movement for the Intellectually Disabled of Singapore. Their ages ranged between 5.3 to 17.08 years with average of 12.08 years. SD; 3.3. Criterion for the selection was that all the participants had been previously diagnosed as mental retardation and its synonyms. A series of tests and clinical observations were carried out to detect primitive reflexes. Despite there are many other major primitive reflexes, such as, Moro and Spinal Galant Reflexes, I presented only three most common reflexes,

Asymmetrical Tonic Neck Reflex, Symmetrical Tonic Neck Reflex , and Tonic Labyrinthine Reflex because there are page and time limitation.

Physiotherapy comprehensive assessment was done for the students periodically and impairments and functional limitations were documented.

Background status of participants

	<u>IQ</u>	<u>No. of students</u>	<u>%</u>
Severe	20 - 35	12	16.7 %
Moderate	31 - 51	44	61.1 %
Mild	52 - 66	16	22.2 %

Test Battery

Primitive Reflexes

Tests

Asymmetrical Tonic Neck Reflex	1. Arm Extension Test (ATNR) (Schilder test,1973)
Tonic Labyrinthine Reflex (TLR)	1. Head Extension and Flexion (erect position)
Symmetrical Tonic Neck Reflex (STNR)	1. Standard test (4 point kneeling position)

When standard testing is not feasible, presence of abnormal reflexes can be detected during activities.

Positive signs of presence of Primitive Reflexes

1. Asymmetrical Tonic Neck Reflex (ATNR)

- **Rolling**
 - a) Child uses ATNR to roll by turning face to elicit extension and build momentum for rolling
 - b) Child occasionally uses ATNR to roll in milder case.
- **Crawling**
 - a) Crawl homolateral pattern
 - b) Crawl homolateral uses intermittently with reciprocal in milder case.
- **Kneeling Balance** (The child is to look up to each side)
 - a) Arms assume ATNR posture as the child rotate head (check whether the head is facing left or right
 - b) ATNR present to one side only: or posture in arms changes in mild response

2. Symmetrical Tonic Neck Reflex (STNR)

- **Crawling**
 - a) Crawl up and down homologous pattern
 - b) Crawl homologous pattern uses intermittently with reciprocal up and down.
- **Kneeling , head flexion and extension**
 - a) Definite change in joint position
 - b) Slight change in joint position

3. a) Tonic Labyrinthine Reflexes (TLR) (Flexion)

- **Kneeling Balance** (Child is directed to look down at knees and to remain kneeling)
 - a) Child collapses in flexion.
 - b) Child exhibits increase flexor tone when head is Flexed [Shoulder, trunk, and hips]

b) Tonic Labyrinthine Reflexes (TLR) (extension)

- **Kneeling Balance** (Child is directed to look up at ceiling and to remain , kneeling)
 - a) Shoulder retract and hip hyperextended (lordotic posture) when head tilts back.
 - b) Some increase in extension evidences either hip, shoulder, or both.

Scoring

- Scoring during the test procedure was based on a standardised scale of 0 -4 (Capute et al. 1984)
 - 0 = No Abnormality Detected (NAD)
 - A positive result indicating deviation from 0 (no abnormality detected) was scored in increments of 25% (1,2,3,4)
 - A score of 4 = a fully retained primitive reflex, absence of a postural reflex or inability to carry out the test.

Analysis

A score of 0 is the currently accepted norm on the above tests; a score of > 0 indicating dysfunction. For this study, a score of 1 or greater than 1 was recorded as a positive score. The number of participants with a positive score on each test was recorded and expressed as a percentage.

Results

Number of participants out of 72 with a score of >1 =	68 students -	88.9 %
Asymmetrical Tonic Reflex (together with other reflexes)	40 Student	55.5%
Symmetrical Tonic Reflex (together with other reflexes)	43 Students	58.8%
Tonic Labyrinthine Reflex (together with other reflexes)	53 Students	73.5%

Linkage of retained primitive reflexes (single and combined) with dimensions of disablement

Table 1 (Pathophysiology & Impairment)

Primitive Reflexes	Positive score / Percentage	Pathophysiology		Impairment		
		Birth history	Others	Postural defect	Postural adjustment	Coordination movement
ATNR	3	NVD - 3	—	—	1	0
STNR	4	NVD - 4	Fit - 1	Lordosis - 3	1	0
TLR	10	NVD - 10	—	Lordosis 1	1	1
ATNR +TLR	4	NVD - 4	Fit - 1	Kyphosis - 1	2	2
STNR TLR	9	LSCS - 1 NVD - 8	Fit - 1	Kyphosis - 3	3	2
ATNR +STNR +TLR	3 ¹ / ₃	LSCS -13	Fit 5 Epilepsy (3)	Kyphosis - 15 Scoliosis - 5	3	2

NVD- Normal Vaginal Delivery

Table 2 - Linkage with reflexes and Limitation of function / Action (Gross motor)

Gross motor Activity	ATNR	STNR	TLR	ATNR+TLR	STNR+TLR	ATNR+STNR+TLR
Running						
-Unable to run	-	-	-	-	-	6
-Run with jerky Award , poor rhythm	1	1	4	1	1	16
-Run smoothly without proper arms usage	2	2	4	-	2	11
-Arm and leg opposition, small ROM	-	1	1	3	6	Nil
Jumping						
-Unable to jump	1	-	1	1	1	12
-Jump with one leg after the another up and down	1	3	5	-	3	13
-Jump with both feet up and down	1	1	3	4	5	8
Catching						
-Unable to catch	3	3	4		3	23
-Scoop a rolling ball to the body	-	1	3		2	8
-Catch bounced ball with arm and body	-		2		4	2

Discussion

There are relatively high incidence of relationship with retained primitive reflexes and pathophysiological disablement. The 33 participants who have been detected with persistent primitive reflexes have background birth history of LSCS. This indicates a 39.3 % in the incidence relationship of LSCS with pathophysiological disablement that is relatively high in comparison with the children who were delivered via normal vaginal delivery.

STNR (individual) (4 participants)	3 Lordosis deformity	75 %
STNR +TLR (9 participants)	3 Kyphosis ² posture.	33%
STNR, STNR + TLR (33)	15 Kyphosis	39.4%
	5 Scoliosis	15.2%

The results suggest that whilst individual reflex abnormalities impair functioning in specific skills, the combined effect of a cluster of aberrant reflexes will have predominantly intractable “organic” problem in children with ID

Earlier research has linked abnormal primitive and postural reflexes to problems with balance and coordination (Ayres 1972, Pyfer and Johnson 1981), and children with learning disabilities (Rider 1972, Wilkinson 1994). In the aspect of postural adjustment (including - postural accompaniment , equilibrium, and protective reaction), the result of this sample show that almost all the participants have problems in one or more of the components of postural adjustment , especially in postural accompaniment.

The incidence of linkage retained primitive reflexes together with difficulties carrying out related motor tasks in this sample is high. (Table-2). It suggests that abnormal reflexes do affect the acquisition and automisation of more complex motor dependent skills.

² Kyphosis - Excessive backwards curvature of thoracic spine / Lordosis - Excessive forwards curvature of lumbar spine.
Scoliosis - Lateral curvature of spine .

Conclusion

In view of the evidence, it seems reasonable to conclude that persistent primitive reflexes was a significant factor in this group of children diagnosed with mental retardation. Assessment of primitive and postural reflexes in the older children can help to isolate underlying neurological dysfunction so that recommendations for remedial treatment also include appropriate exercises in addition to specialist teaching.

The knowledge of reflex chronology and normal child development may be combined to provide to predict which later skill may have been impaired as a direct result of retained primitive reflexes. It may be said that individual aberrant reflex can give us clues as to what is actively hindering latter skill. Each reflex has vital parts to play in setting the stage for later functioning.

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