MNRI® for Children with Cerebral Palsy

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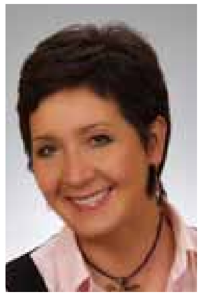
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This abstract presents a study published in 2008 in the article, *Masgutova Method of Reflex Integration for Children with Cerebral Palsy*, edited by Susan Wenberg, M.A., D.C., and Mary Rentschler, M.A. at www.MasgutovaMethod.com.

Cerebral Palsy (CP) and Primary Motor System Development

"Infantile Cerebral Palsy" (S. Freud), the group of diseases concerned with motor disorders as the result of brain damage or dysfunction of certain brain centers, is usually acquired during the first years of life, at the time when the system of primary movement patterns is developing. Primary movements are genetically programmed not only for protection and survival, but also for the development of the conscious movement system. Developmentally their role is to support:

- maturation of the nervous system (synaptogenesis, myelination and brain plasticity)
- brain functions (cognitive development, emotional maturation)
- sensory-motor integration.

Dysfunctions of motor development and sensory-motor integration in the child with CP reflect the type of neurological insult and the developmental stage of the infant/child when the neurological insult occurred. The developmental stages can be divided into prenatal (in utero); natal (during the birth process); or postnatal (during the first years of life). Each developmental stage is vulnerable to specific neurological insults.

Prenatal palsy can be caused by infection, intoxication of the fetus, or compromised health of the pregnant mother. Many primary motor patterns and reflexes develop in utero, such as Trunk Extension, Automatic Gait, Hands Grasp, Swallowing, and Sucking. Prenatal brain damage will cause poor expression of these reflexes and adversely impact the next stage of development.

Natal palsy is generally caused by a neurological insult during birth: a consequence of premature birth, sudden delivery, narrow pelvis of the mother, use of forceps during delivery, etc. Natal trauma can negatively affect the activation of primary motor patterns and reflexes characteristic of a normal successful birth. In such cases the expression of these genetic programs will be abnormal. The primary movements and reflexes of childbirth, such as Head Righting, Spinal Perez, Tonic Labyrinthine in Extension, Crawling, Sequential Side Rotation, Spinning, and Sucking may be dysfunctional.

Postnatal palsy is often caused by an infection with encephalitic symptoms. Other causes include childhood cranial injury, central nervous system injury, and poor systemic health. Infant motor patterns and reflexes will be stressed by postnatal CP, and may develop dysfunctionally or pathologically. Dynamic reflexes

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(Grasp, Hands Pulling, Automatic Gait), positional reflexes (Asymmetrical Tonic Neck, Symmetrical Tonic Neck, Babkin Palmomental, Labyrinthine Tonic in Flexion and Extension), and postural reflexes (Trunk Extension, Spinal Perez, and Galant) are most commonly affected.

Impaired motor function associated with central nervous system damage in all types of CP may be due to:

- poor sensory perception of stimuli (tactile, visual, auditory, olfactory, vestibular, proprioceptive)
- dysfunctional or pathological processing of sensory stimuli, such as poor recognition or invalid decoding
- inadequate motor response due to abnormal muscle tone or musculoskeletal problems such as orthopedic injury or abnormality.

Motor development is a primary expression of coordinated neurological function in infant and early childhood development. In the child with CP, impaired motor function contributes to disorders in auditory and visual perception, memory, speech, and self-organization. These, together with motor problems, will influence the future development of all other spheres: physical (insufficient muscle bulk, structural weakness or abnormalities), emotional (anxiety), cognitive (sensory processing disorder, learning disabilities), and personality (lack of confidence, timidity).

Both genetically encoded primary motor patterns and consciously learned and controlled motor function are impaired in the child with CP. In MNRI® our focus is on techniques that support primary motor patterns. We define these as genetically programmed reactions that range in complexity from simple reflex responses occurring at the spinal cord level, to more complex survival-based response patterns involving brain stem activity, to sensory-motor coordination systems (hand-eye, eye-ear, etc.) and finally, to more complex activities (visual tracking of a moving object, articulation for pronouncing sounds, etc.).

Because they are natural resources that support synaptogenesis, myelination, and optimal brain function, primary motor patterns are crucial for future development. Each step of development is based on kinesthetic memory (genetic and individual), which allows us to internalize all types of movements. Studies show kinesthetic memory to be damaged in 40-60% of children with CP (N.N. Danilova, A.L. Krilova, 1997). With motor and cognitive development limited by poor kinesthetic memory, even the simplest motor skills are very difficult for the child with CP to explore and anchor into memory. In the MNRI® model, neurosensorimotor reflex integration awakens latent brainstem genetic motor memory, so that it may serve as a resource for neurodevelopment.

Characteristics of Neurotypical Early Childhood Motor Development

To understand the uniqueness of early motor development in children with CP, it is helpful to compare their reflex pattern formation to that of a healthy child. This comparative analysis offers a profound understanding of the dysfunctional features characteristic of CP and allows us to design therapeutic interventions using developmental techniques that influence the sensory-motor links of the reflex circuit.

During the first 1½ -2 months of life, a number of reflexes develop in sequence, including the Tonic Reflexes: Tonic Labyrinthine, Symmetrical and Asymmetrical Tonic Neck, Head Righting and Trunk Extension Reflexes, and pelvic-trunk movement patterns. The individual reflexes are difficult to detect as they normally mature into other reflex patterns, and are naturally integrated into the movement system by three months of life. They are complex, resulting from spontaneous activity in the brainstem, vestibular-cerebellar centers, motor cortex centers, nuclei of the vision centers and the corpus striatum. Coordination of these areas determines the control of muscle tone and muscle activity.

During the first year a healthy child develops still more reflexes and primary movements, including antigravity reactions and supporting motor patterns (Gravity, Grounding, and Stability Reflexes; Automatic Gait, Crawling, Spinal Galant and Perez Reflexes, Grasp, Oral Automatisms, etc.)

A primary reflex, Labyrinthine Head Righting, develops as an antigravity function, allowing the supine infant to raise his head by the age of two months. It triggers him to lift his head when pulled by the hands, or when lying prone. Head Righting is mainly controlled by the labyrinthine nuclei and medulla oblongata. In children with CP, this reflex is not typically expressed until the fifth month or later.

Thanks to the development of this reflex pattern, a healthy six-month-old infant placed on his stomach is able to support his upper body on his forearms, to lengthen his trunk in an arc, using appropriate muscle contraction, and to flex his legs above ground. Later in development the child is able to turn over, to get on all fours, to crawl, and to sit without support. The Head Righting Reflex is the basis for all these movements. It is controlled by vestibular-cerebellar structures in the medulla spinalis, medulla oblongata, and the reticular formation of the brainstem.

In the second year of life the combination of the Tonic Labyrinthine and the Symmetrical and Asymmetrical Tonic Neck Reflexes helps the child learn how to control its body position at rest and how to move through space.

Characteristics of Early Motor Development in a Child with CP

All reflex patterns described above for healthy infants are dysfunctional or pathological in children with CP, and their expression is delayed by eight years or more. In CP with severe brain damage there is minimal development of the righting reflexes (Child Neurology, 2000); K. Bobath, 1972; L.O. Badalian, 1984; R. Michalowicz, 1993; C.H. Delacato, 1974; G. Doman, 1984; V. Vojta, 1989; K.B. Nelson, J.H. Elleberg, 1979; K.A. Semionova, 1999; D. E. Haines, 2002; L. Sadowska, 1998; S. Masgutova, N. Akhmatova, 2004; S. Masgutova, 2007).

Our observation and understanding of reflex patterns in children with CP has allowed us to identify dysfunction or pathology in a number of reflex patterns such as the Tonic Labyrinthine in Flexion and Extension, Robinson Grasp, Babkin Palmomental, Leg Cross Flexion-Extension, Asymmetrical Tonic Neck, Thomas Automatic Gate, Bauer Crawling, Moro, Hands Supporting, Segmental Rolling, Symmetrical Tonic Neck, Spinal Galant and Perez, Spinning, and Pavlov Orientation.

Pathological reflexes and movement patterns in children with CP are especially related to a lack of timely development, maturation and integration of tonic reflexes. Tonic reflex patterns, triggered by movement or changes in body position or in the relationship of the head to gravity, strengthen the functional links between the vestibular system and the musculoskeletal system; thus, supporting appropriate muscle tone, proprioception, posture, and motor control. The vestibular system reflexes are linked with the work of the extra-ocular and spinal muscles, creating the ground next for righting reflexes. These neurological links are modulated and matured via tonic reflexes.

Several important reflexes whose expression in children with CP is abnormal, are noted below:

1. Tonic Labyrinthine Reflex (TLR). A prone child with CP, regardless of age, demonstrates abnormally high tension in the upper and lower limbs, flexors, and abdominal muscles. The child can not raise his head, straighten his core, or extend his arms and legs – movements that are typical for a 3 -6 month old healthy child. If the child with CP is supine, the tone of extensors in the limbs increases. In severe cases, spasticity is present. A pathological TLR adversely affects the way the child sits, turns over, and stands up. It also can affect the tongue muscles, blocking articulation and preventing stimulation and development of Broca's area (speech center) and subcortical links in the brain. A pathological TLR also causes poor head position and abnormal function of the oculo-motor abductors. As a result, the child has a limited view of the objects around him/her, leading to poor development of vision. When sitting or standing, joints are overly flexed and the child has difficulty extending his limbs.

2. Symmetrical Tonic Neck Reflex. When the child with CP is put into position to test the Symmetrical Tonic Neck Reflex the head is flexed on the chest. The child's response is increased tone in the flexors of the arms and extensors of the legs. When the head is tilted backwards, tone in the limbs reverses: it increases in the leg flexors and arm extensors. This abnormal reaction causes problems with the development of postural control, inhibits the formation of the links between postural control and binocular vision and near-far accommodation, and blocks the development of superior and inferior eye muscles.

3. Asymmetrical Tonic Neck Reflex. If we turn the head of a healthy newborn lying supine to the side, the arm and leg on the same side will extend, and the opposite arm and leg flex. In a child with CP, often the limbs flex on the same side to which the head turns, or there is a global hyperactive response. This abnormal reaction is a protective response that does not support sensory awareness or orientation to the environment.

4. Segmental Rolling Reflex. This motor pattern is of crucial importance for infant development. If not developed and integrated, the child cannot rotate the shoulders independently of the pelvis. This is seen in the child with CP who cannot separate movements of different body parts. Abnormalities in the development of the Segmental Rolling Reflex prevent free balancing of the trunk while walking: the individual will have poor balance and limited ability to make subtle adjustments in response to gravity. Clinical observations include unstable and inappropriate leaning to the side and poor control of posture and movement.

5. Hands Grasp Reflex. Another reflex linked to tone and tonic function is the Robinson's Hand Grasp Reflex.

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It should mature near the end of the first week, integrate with Hands Pulling by the second month, and mature to allow for easy expression of manual skills by the end of the first year. However, the Robinson's Hand Grasp Reflex can become fixed and reactive in the child with CP so that after grasping an object, he cannot relax the palm and open the fingers to release it. Children with CP who have low muscle tone will not be able to explore the grasp motor pattern as a possibility for flexing the fingers and palm into a fist for holding, or for the development of manual skills. Manual skills represented in the area of the sensory-motor cortex are strongly correlated with speech centers: Wernicke's area (auditory center for recognition of human speech), Broca's area (articulation of phonemes and sounds) and subcortical areas that integrate speech functions (W. Penfield, T. Rasmussen, 1950). Thus poor development of the Robinson's Hand Grasp Reflex may negatively influence speech formation in the child with CP.

In normal infants the tonic reflexes discussed above begin to integrate in the second month of life. In children with CP adequate reflex responses never occur. The abnormal patterns that emerge instead, involve muscular hyper-contraction and pathological muscle synergies, which limit joint mobility and morphological development, as well as movement. The expression of these pathological patterns is strikingly evident in the first year of life.

In the second year of life, hyperkinesis (unintentional movements) may be diagnosed. Hyperkinesis will involve the tongue, causing the lower lip to protrude. Abnormally high tension in the trunk and limb muscles and poor coordination in the hands may also be noted.

Abnormal muscle synergies underlie all the stereotypical pathological motor patterns of children with CP. As noted above, these abnormal synergies, expressed as abnormal tone, posture, and movement, are linked to abnormal tonic reflex patterns. In summary, the complex process of natural reflex development in children with CP is impaired. Depending on the location of the brain damage, different pathological pattern schemes are formed in the cortex and in the subcortical areas.

MNRI® Assessment of Reflex Motor Pattern Expression

Table 1 (below) shows 24 reflexes grouped according to body planes and motor coordination systems. Motor patterns for reflexes 1-8 relate to a median/axis plane dividing the body between right and left, referred to in anatomy as the sagittal plane. The sagittal body plane involves differentiation and coordination of movements of the right and left sides of the body. Motor patterns for reflexes 9-16 activate the upper and lower parts of the body, related to a horizontal plane. Reflexes 17-24 relate to a dorsal plane dividing the body between front and back.

Table 1. MNRI® Assessment Results for a Group of 480 Children Diagnosed with CP

MCS		Deeply Dysfunctional and Pathological Reflex Patterns in Children with Cerebral Palsy	Total Number of Children: 480	
			Number	Percentage
Right/Left SAGGITAL	1	Robinson Grasp	270	56.3
	2	Hands Pulling	152	31.7
	3	Babkin Palmomental	269	56.0
	4	Babinski	360	75.0
	5	Leg Cross Flexion-Extension	279	58.1
	6	Asymmetrical Tonic Neck	286	59.6
	7	Abdominal	260	54.2
	8	Bonding	168	35.0
Up/Down HORIZONTAL	9	Thomas Automatic Gait	360	75.0
	10	Bauer Crawling	310	64.6
	11	Moro	286	59.6
	12	Fear Paralysis	312	65.0
	13	Hands Supporting	317	66.0
	14	Segmental Rolling	334	69.6
	15	Landau	427	89.0
	16	Flying and Landing	410	85.4
Front/Back FRONTAL	17	Trunk Extension	319	66.5
	18	Symmetrical Tonic Neck	312	65.0
	19	Spinal Galant	320	66.7
	20	Spinal Perez	325	67.7
	21	Tonic Labyrinthine	370	77.1
	22	Foot Tendon Guard	327	68.1
	23	Spinning	344	71.7
	24	Pavlov Orientation "What is this?"	176	36.7

A group of 480 children with CP were evaluated for reflex pattern integration using the MNRI® Assessment protocol. Table 1 shows the number and percentage of children from the group whose scores fell in the pathological or deeply dysfunctional range for 24 reflex motor patterns.

For norms and levels of the MNRI® Assessment protocol, see the chapter, *MNRI® Assessment for Determining the Level of Reflex Development*.

As Table 1 shows, a very high percentage of individuals in this group demonstrated dysfunction and pathology in their expression of reflex motor patterns. In a neurotypical population all of the reflex patterns would be functional, in the usual distribution around the norm.

Masgutova Neurosensorimotor Reflex Integration (MNRI®)

MNRI® therapy uses an approach of correction and coordination of sensory and motor components of the dysfunctional reflex pattern circuits. 'Re-patterning' exercises and techniques (re-education, re-coding/re-setting of schemes) 'revive traces of genetic motor memory and reactivate the physiological circuit.' These interventions stimulate the correct expression of genetically encoded resources, such as programs of self-regulation, self-defense, and stress release. 'Re-patterning' aimed at reactivation of links between the neurostuctural aspect of a reflex pattern and its protective task (I.M. Sechenov, 1895, A.A. Ukhtomsky, 1950-1952) stimulates synaptic growth and myelination (L. Lundy-Ekman, 2002). MNRI® therapy procedures use specific protocols developed by Dr. S. Masgutova and her co-authors. These include *Neuro-Structural Reflex Integration* (2003), *Tactile Therapy* (2005), *Dynamic and Postural Reflex Pattern Integration* (2004), *Visual and Auditory Reflex Integration* (2007), *Breathing Reflex Integration* (2012), and others.

Historically, children with CP are the largest patient group in our work. Our research on their primary motor patterns has helped us identify specific dysfunctional reflexes and design individualized programs that restore function as reflex expression becomes more normalized. The study presented below demonstrates the effectiveness of MNRI® as an intervention for these children.

Application of the MNRI® Program to Children with CP

The study involved a group of 42 children with CP ranging in age from 2 to 8 years. They attended either a 14-day therapeutic clinic at the International Masgutova Institute of Movement Development and Reflex Integration in Warsaw, Poland (31 children) or a 10-day MNRI® Family Educational Conference sponsored by the Svetlana Masgutova Educational Institute, USA (11 children). MNRI® Assessments were done on each child before and after 10 or 14 days of a MNRI® treatment conference or clinic.

Each program consisted of 6 -7 hours per day of treatment that included active structural motor therapy and passive procedures.

Table 2 presents examples of a statistically significant validation of the synthesized function z = f(x). Function z = f(x) is the synthesized function of changes in reflex pattern development (z) and presents synthesized information of chosen diagnostic parameters (x). Each parameter (x) shows the level of development of a specific reflex pattern as measured according to the criteria of MNRI® reflex pattern assessment; this function allows us to measure each parameter (x) for each individual child.

Table 2. Changes in Reflex Pattern Development (Dorsal Plane)

Nr of an Individual	Assessment	X17	X18	X19	X20	X21	X22	X23	X24	Z (Coefficient of the change)
Child 1	Before MNRI®	5	5	7	5	4	5	4	8	0.351
	After MNRI®	8	8	9	7	7	7	5	9	0.472
Child 2	Before MNRI®	14	11	5	3	6	3	6	5	0.382
	After MNRI®	15	13	8	4	15	5	9	13	0.611

Function z = F(x) is the synthesized function of changes in reflex pattern development (z) and presents synthesized information of chosen diagnosis parameters (x).

The columns in Table 2 show Assessment results for specific reflex patterns as follows: X17 – Trunk Extension, X18 – Symmetrical Tonic Neck, X19 – Spinal Galant, X20 – Spinal Perez, X 21 – TLR, X22- Foot Tendon Guard, X 23 – Spinning, and X24 – Pavlov Orientation. The 'before' and 'after' numbers represent points on a continuum of reflex development ranging from 0 (deep pathology) to 20 (high level of integration) with 15/16 representing the norm and 10 representing the boundary between dysfunctional and functional.

In Figure 1 we see an example of the changes in development of reflex patterns within the dorsal body plane of child 1. Mathematical statistical analysis demonstrates the statistical importance and validity of

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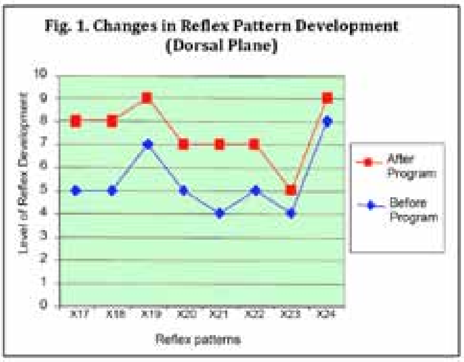


Fig. 1. Changes in Reflex Pattern Development (Dorsal Plane)

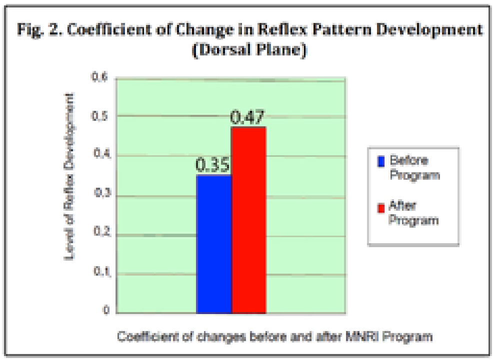


Fig. 2. Coefficient of Change in Reflex Pattern Development (Dorsal Plane)

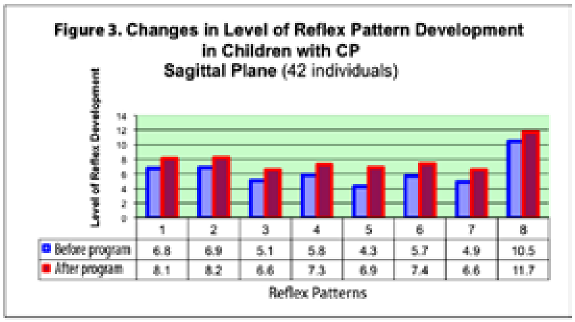


Figure 3. Changes in Level of Reflex Pattern Development in Children with CP Sagittal Plane (42 individuals)

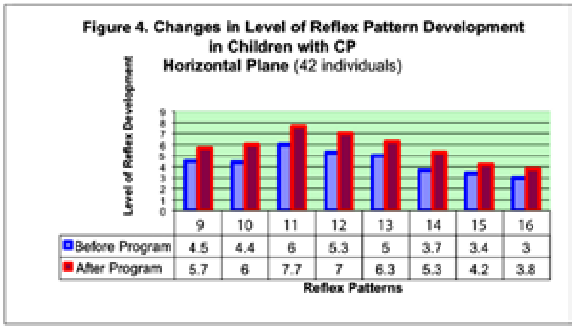


Figure 4. Changes in Level of Reflex Pattern Development in Children with CP Horizontal Plane (42 individuals)

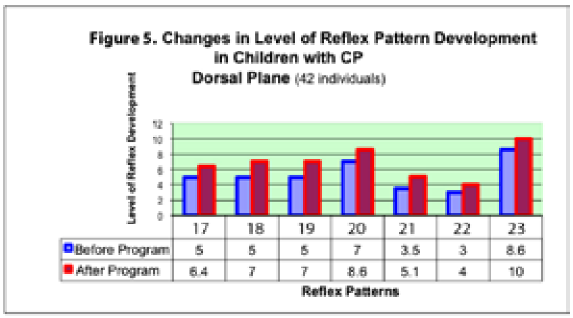


Figure 5. Changes in Level of Reflex Pattern Development in Children with CP Dorsal Plane (42 individuals)

these changes within each reflex pattern and also for the whole group of reflex patterns involving the dorsal body plane/MCS (Fig. 2). This type of analysis was used for all diagnostic parameters of reflex patterns for each child, with comparison of results before and after the MNRI® Program, for all three body/motor planes: sagittal, horizontal, and dorsal. Figure 2 shows an example of the coefficient of changes (z) by Prof. A. Krefft (2007), which demonstrates the statistical validity of the changes in expression of reflex patterns within this group.

Bar Graphs in Figures 3, 4 and 5 show examples of dynamic changes in the expression of reflex patterns for all three body/motor planes after 14 or 10 days of utilizing the MNRI® Program.

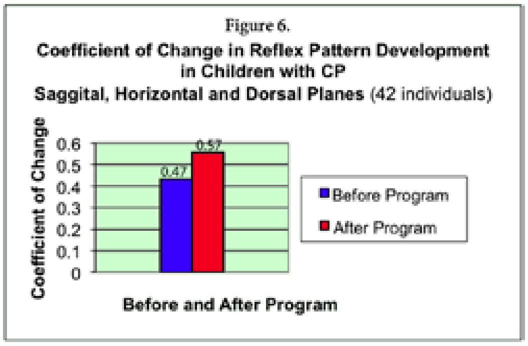
Figure 3. Changes in Level of Reflex Development: Sagittal plane. Again MNRI® Reflex Assessments after the MNRI® program indicated solid gains in reflexes belonging to all three body planes/MCS. The average rate of improvement in the sagittal group was 1.6 points (from 6.25 points before the MNRI® program to 7.85 after); in the horizontal group 1.69 (from 4.41 before to 6.10 after); and in the dorsal group 1.6 (from 5.3 before to 6.9 after). Clinical observations also confirm improvement in reflex patterns demonstrated by decreased pathological muscle tone, improved muscle tone regulation, decreased hyperactivity in protective responses (Fear Paralysis and Moro) and improvement in righting reflexes (Trunk Extension and Head Righting), gross motor coordination (Crawling, Automatic Gait, Perez, and Galant), manual skills (Hands Grasp, Hands Pulling and Hands Supporting), and balance.

Figure 6. (next page) Coefficient of Change in Reflex Pattern Development in Children with CP: Sagittal, Horizontal and Dorsal Planes. Mathematical statistical analysis shows remarkable improvement in reflex pattern expression in the group of children with CP after attending the MNRI® program. The coefficient of change is 0.43 before the MNRI® Program and 0.56 after, indicating statistically significant change. (Fig. 6).

The lineal error in projection of changes is not more than 1.87 – 2.82 %, again supporting the conclusion that the MNRI® program resulted in statistically significant changes in reflex pattern expression in these children.

Summary

The powerful resources of innate reflex patterns are present in everyone, serving as a foundation for motor development, sensory integration, and all our higher-level cognitive and emotional skills. The strength of this foundation depends on the coordinated activity of sensory and motor neurons and effective synaptic transmission, all essential for correct reflex pattern expression. Stress/distress, disease and injury can interfere with reflex development and functioning. Fortunately, at any age we can reawaken, repattern, or rebuild them. This is the purpose of MNRI®.



Forty-two children with CP demonstrated significant improvement in expression of primary sensory-motor patterns associated with infant Dynamic And Postural Reflexes following 10 or 14 days of MNRI® therapeutic programs. Statistical analysis supports the effectiveness of the MNRI® diagnostic protocol and validates the results of the therapeutic part of the program.

The outcome of this study strongly supports the early application of corrective procedures directed at the level of reflexes. Its results have been replicated over and over again by families who have sought MNRI® treatment for children and adults with CP and many other developmental challenges. The natural, non-invasive MNRI® techniques used clinically by professionals and applied by parents in home programs have brought successful remediation and progress toward functional health to thousands of challenged individuals.

I thank and congratulate the children doing all that is possible to improve their sensory-motor reflex patterns and skills and teaching us to value life - with their smiles and amazing motivation!
– Dr. Masgutova

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