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Changes in psychomotor indicators of children with autism during intensive neurophysiological rehabilitation

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Background. Intensive Neurophysiological Rehabilitation System has been created for treatment of kids with Cerebral Palsy (CP), is used for more than 30 years and combines more than a dozen of multidirectional treatment techniques which potentiate and complement each other. Numerous examinations of changes in abilities of children showed than this method has a positive influence not only on motor functioning but also on cognitive functions like memory, attention, intellect, speech, emotional state.

Patients and methods. *Prospective study. 39 children with child autism (F84.0) were monitored from October 2015 to October 2016 during one year).*

To assess the effectiveness of rehabilitation psychopathological method, complemented by Child autism rating scale (CARS), Autism treatment evaluation checklist (ATEC), neurological (neurological status, assessment of muscle tone according to Ashworth scale, goniometry) and psychodiagnostical (coloured Raven matrices) methods were used. Also videorecording of gross motor functions before and after each treatment course was done.

Results. According to received outcomes after rehabilitation of children with autism by INRS positive changes in motor development were observed, namely the reduction of muscle tone in the distal parts of lower extremities in 96±10% patients, increase in volume of active and passive motions in 92±9%, improvement in fine motor functioning in 44±6%, emergence of new gross motor skills in 14±4%. During rehabilitation communicative skills and overall socialization of patients improved in 46±7% patients, reduction of autistic symptoms was observed (average ATEC score was 66±10 points before and 51±6 after), the amount of children within normative range of intellectual development significantly increased. The positive dynamics in formation of speech function was observed in 62±7% patients: understanding of spoken language improved, speech rate sped up, symptoms of dyslalia decreased, transition to a higher stage of speech development happened.

Conclusions. During treatment by INRS positive transformation of the pattern of indicators is observed. It reflects actual neuropsychiatric condition and level of communicative, intellectual and speech development of children. INRS can be implemented for efficient treatment of patients with ASD due to normalization of their motor, communicative, intellectual and speech development during rehabilitation.

Keywords: childhood autism, ASD, INRS, rehabilitation.

Background

During last years questions of treatment and rehabilitation of patients with autism are one of the most important in child neurology. Prevalence of autism in USA is now assessed as 1 in 68 children [1]. Results of epidemiological studies in Europe, North America and Asia demonstrate average prevalence of Autism spectrum disorders (ASD) as 1% [2]. Morbidity rate doesn't depend on racial, ethnic and social-economical peculiarities [3]. Scientists don't know the exact causes of autism, but research suggests that genes and environment play important role. Risk factors include: gender — boys are much more likely to be diagnosed with autism than girls; existence of a sibling with autism; having a mother older than 35, and/or a father more than 40 when the baby was born; genetics — 20% of children with autism also have certain genetic conditions like fragile X syndrome, Down syndrome, tuberous sclerosis [4]. It is observed that children with ASD are on the higher side of height and on the lower side in their weight when compared to normal children due to malnutrition and low energy intake [5]. This is reflected in their BMI which is below the normal value [6].

In recent years, the number of children identified with autism has increased. Experts disagree about whether this shows a true increase in autism since the guidelines for diagnosis have changed in recent years as well. Also, many more parents and doctors now know about the disorder, so parents are more likely to have their children screened, and more doctors are able to properly diagnose

Demographic Characteristics of the Children

Variable	Distributions (n=36)
Age, y	
Mean (SD*)	4y 2months ± 8months
Min-Max	3-18
aged <4 years of age	13 (36%)
4 to 8 years	11 (31%)
8 to 12 years	7 (19%)
older than 12 years	5 (14%)
Sex	
Male	27 (75%)
Female	9 (25%)

Note: *SD – standard deviation.

autism, even in adulthood. Now there is more kids with autism than those with diabetes, oncology and AIDS.

Rehabilitation of children with autism has a huge medical, social and economical load on budget because these patients leave ill with appropriate needs when became adults. In USA care for one patient with autism during life costs $3.2 million, for all $137 billions [7].

There is a huge amount of treatment approaches for treatment of children with autism. In the manual of National Autistic Society of Great Britain «Approaches to correction of autism» more than 70 methods of treatment are described [8]. Generally 2 main kinds of treatment for autism exist: psychopharmaceutical and psychocorrectional [9]. Because of insufficiency of current rehabilitation approaches effectiveness there is an urgent need to search for new therapies for this disease. In this context attention should be paid on the data represented in the article of J. Alcantara about effectiveness of a relatively new approach for rehabilitation of autism spectrum disorders (ASD), namely manual therapy [10]. Currently in medical databases exists only few articles addicted to this kind of treatment for autism. According to these data, usage of manual therapy for treatment of autism is effective but sanogenetic mechanisms of the influence are yet to be discovered [11].

As known, by prof. Kozyavkin highly effective system of Intensive neurophysiological rehabilitation (INRS) has been created [12]. INRS has been developed for treatment of kids with Cerebral Palsy (CP), is used for more than 30 years and combines more than a dozen of multidirectional treatment techniques which potentiate and complement each other [13]. Pivotal part of the therapy is biomechanical correction of the spine as a type of a manual therapy adapted to the needs and anatomical peculiarities of the child's body. Numerous unbiased examinations of changes in mental abilities ped children with Cerebral palsy showed than this method has a positive influence not only

on motor functioning but also on cognitive functions like memory, attention, intellect, speech, emotional state [12]. Based on these findings we can assume efficiency of this rehabilitation system for treatment of children with autism.

The purpose of the research has been an assessment of INRS rehabilitation efficacy by studying changes in their psychopathological, neurological indicators as well as motor capabilities.

Patients and methods

Prospective study. Observation period took place during 1 year from October 2015 to October 2016. Criteria for inclusion were age of the child from 3 to 18 years old, correspondence to diagnostic criteria «Child Autism» described in DSM-V, presence of autistic signs according to Childhood Autism Rating Scale (CARS) [14] for children ≥ 3 years or Autism Spectrum Screening Questionnaire (ASSQ) [15] for children ≥ 6 years, passing at least one course of INRS treatment.

A total of 39 children took part in the study with an established diagnose «Childhood autism» (F84.0). 3 children were excluded because of different biased and unbiased reasons. Table 1.

Comparison of the data has been done 3 times: before the onset of the rehabilitation, after completion of a 2-week treatment course and at the end of the last treatment course (if patient visited Clinic more than once during the year of observation).

In order to assess the effectiveness of rehabilitation psychopathological method, complemented by Child autism rating scale (CARS), Autism treatment evaluation checklist (ATEC), neurological (neurological status, assessment of muscle tone according to Ashworth scale, goniometry) and psychodiagnostical (coloured Raven matrices) methods were used. Also videorecording of gross motor functions before and after each treatment was done.

CARS (Children Autism Rating Scale) allows us to assess the level of autistic symptoms severity and compare it over time [14]. Evaluation was conducted in 15 subscales: relationships with people; ability to imitate; emotional and perceptual processes; motor skills; ability to adequately use items; capacity for adaptive change; violation of visual perception; breach of taste, olfactory, tactile perception; anxiety reaction and fear; development of verbal communication; development of non-verbal communication; the overall level of activity of the child; the development and learning of the sequence; the overall impression of the physician.

Scale evaluating the effectiveness of autism treatments – Autism Treatment Evaluation Checklist (ATEC) created in Autism Research Institute by Bernard Rimland is aimed at evaluation of the effectiveness of any treatment for autism in four scoring areas: language/communication, socialization, sensorics/knowledge, health/physical development/behavior [16].

Color progressive Raven matrices (Raven Progressive Matrices) is a non-verbal test designed to determine the level of intellectual development for children from 4.5 to 11 years of age [17].

Statistics. For data analysis both descriptive (mean, median, standard deviation) and inferencial (statistical hypothesis testing, Students's t-test, confidence interval − p value) statistics were used. To evaluate the results of INRS treatment we used computer analysis of data by way of using automated information systems software for medical institutions ELEKS Avalon, developed specifically for the International clinic of Rehabilitation, the Institute of Medical Rehabilitation and Rehabilitation Center «Elita» [19].

Results

After collecting detailed data about history of the disease and neuropsychiatric examination in 8 (22.2%) children the classical version of childhood autism (F84.0) without other neurological deviations was diagnosed, 9 (25%) children had one-sided / double-sided pyramidal insufficiency (R29.2), 8 (22.2%) children − perinatal CNS lesions (F82), 5 (13.9%) children diagnosed cerebral palsy (G80), 4 (11.1%) − epilepsy (G40), 2 (5.6%) − genetic disorders. Comorbid mental health disorders were also very common and observed in 25 (70%) of children, namely mood disorders in 52%, anxiety disorders in 49%, attention-deficit hyperactivity disorder (ADHD) in 42%, chronic tic disorders in 20%, asthenia in 8%.

When gathering a detailed anamnesis prematurity revealed in 19% of children with autism in comparison to 5% in the general population, of which 9% were born at term gestation less than 33 weeks, and 3% in gestational age less than 29 weeks. By caesarean section 21% of children was born in comparison to a 13% frequency in general population. These data were correlated with low birth weight: for children weighing less than 2.5 kg the incidence of autism appearance was more than twice higher. Body weight more than 4.5 kg was a risk factor for the development of this disease 2 times more often than in the general population). 22% of mothers during pregnancy underwent acute respiratory diseases with hyperpyrexia of 38.0 degrees and above, a figure significantly above the average data for the general population. The study of genomic material and chromosomal studies were performed in 2 patients: the defect of the long arm of the 2nd and 7th chromosome. In 4% of patients cases of autistic spectrum disorders were diagnosed in siblings.

The average marriage registration age of parents of children with autism for men was 30.1 year, for women 26.2 years when data for the mean age of marriage was 25.4 and 23.7 years respectively. The average mother age when borning a child with autism was 28 years and 5 months. That means an increased term of both marriage and parental age when autistic child's is born.
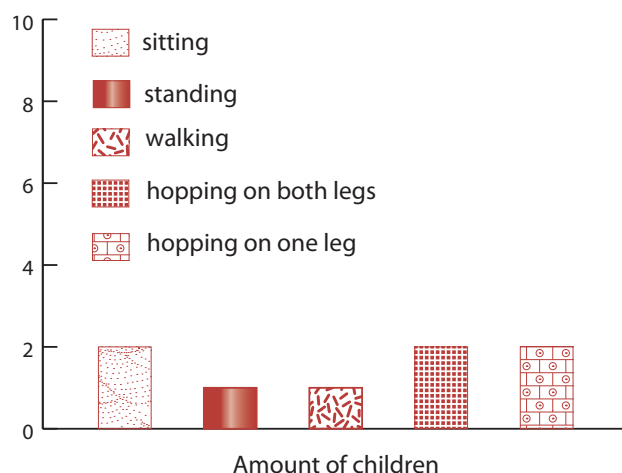

Fig. 1. New motor functions appearance during INRS rehabilitation (n=36)

Breast-feeding rate of the newborns in a population overall is more than 70%, frequency of this type of feeding for mothers of children with autism was only 41%.

Regurgitation is the most common functional disorder among infants and children of the first year of life and occurs in 20-50% of newborns according to various authors. Infant regurgitation was observed in 71% of children with autism and was maintained to 12 months in 19%.

The average age when children with autism began to sit, was 8 months 4 days at an average population rate of 6-7 months, standing achieved at 12 months 6 days at an average population rate of 10 months, walking at 16 months at an average population rate of 12 months.

Ones treated by INRS were 28 (77.7%) children with autism, 3 (8.3%) children have completed treatment twice, 4 (11.1%) child − three times, 1 (2.8%) − more than 3 times. The course of rehabilitation for children with autism lasted for two weeks. The average daily duration of the procedures was 173 minutes per day for primary patients and 201 minutes for patients undergoing two or more courses of treatment by INRS. Longer overall length of procedures in these patients is caused by inclusion of additional methods during second courses/rehabilitations.

All children with autism got a basic set of rehabilitation technologies: biomechanical correction of the spine by the method of prof. Kozyavkin, exercise therapy, wax-parrafin applications, special system of massage and reflexotherapy. Individually were used Light (33 (92%) children), vibrotherapy (33 (92%) of the children), mechanotherapy (30 (83%) children), training on a treadmill (30 (83%) children), joint mobilization (25 (69%) children), computer game therapy with elements of robotic therapy (30 (83%) children) occupational and art therapy (10 (28%) of children), rhythmic gymnastics in groups (9 (25%) of children), «Spiral» suite (2 (6%) children).

It was important to include in each course of rehabilitation the methods of social integration for children
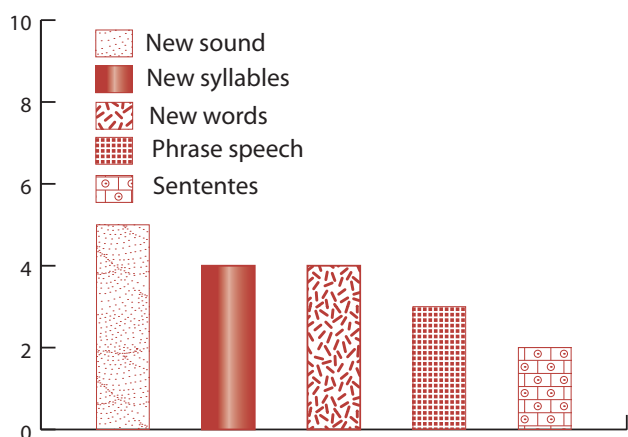
Fig. 2. Appearance of new speech functions in autistic patients after treatment course by INRS

with autism: group competitions, theatrical evenings, drawing contests and other group activities to enhance social integration and communication. Integration of autistic children with children that do not have violations is the most important option, because for sick child it is crucial to have a space for communication with other children [20].

Analysis of the results showed that after a course of treatment by INRS method in 35 (96±10%) patients with autism with a presence of increased muscle tone in the distal parts of lower extremities was observed its reduction, increase the volume of active and passive movements observed in 33 (92±9%) patients. observed better fine hand functioning if it was impaired in 16 (44±6%), accompanied by improved skills in 9 (25±5%) patients.

Motor abilities improved a lot after INRS treatment. In 5 (14±4%) patients 8 new motor functions appeared: 2 (5.6±2.7%) kids started to hop on one leg, 1 (2.8±1.5%) − stand without aid, 2 (5.6±2.7%) to hop on both legs, 1 (2.8±1.5%) to walk by himself, 2 (5.6±2.7%) to sit without aid (Fig. 1.).

The psychoverbal development delay was observed in 32 (89±9%) children before the beginning of the treatment according to the INRS. In 6 (17±4%) children the reduction in the signs of the psychoverbal development delay was observed immediately after the first treatment course and in 2 (6±2%) children − after passing the following treatment course/courses (p<0.05).

Obligatory for this group of patients is diverse and complex infringement of communication, for example disorder of contacting others before the treatment was observed in 34 (94±10%) children. After passing the following treatment courses there was complete reduction of socialization disorders in 17 (46±7%) children, however, in 19 (54±6%) children signs of violations were kept, though their manifestation was less intense (p<0.05).

Deficiency in focusing of an attention was observed in 34 (94±10%) children with autism before the treatment. The significant improvement of characteristics of voluntary attention was marked in 8 (22±5%) children after passing the treatment course according to INRS and in 14 (39±7%) children after passing the following treatment course/courses (p<0.05).

There were positive changes in appearance of new speech functions: new sounds spoken by 5 (14±4%) patients, syllables − 4 (11±4%), words − 4 (11±4%), began to speak by phrases − 3 (8±3%), sentences − 2 (6±2%) (Fig. 2.). Understanding of spoken language improved in 15 (42±6%) children, speech speed increased in 11 (31±5%), dyslalia became less severe in 10 (28±5%).

After repetitive courses of INRS rehabilitation new speech functions appeared and passage to higher level of speech development was observed. In 4 (11±4%) children, which could pronounce only separate words and in 2 (6±2%) patients, who could pronounce only sounds/syllables, phrase speech appeared (Table 2).

Before the rehabilitation by INRS the average score on a scale ATEC was 66±10 points, indicating the presence in children of severe disorders in communication, language functions, socialization and behavior. After completion of rehabilitation, this score decreased to 51±6 points, there was a positive trend of estimated parameters. According to the scale emotional state improvement was observed in 90±9% of children. The biggest changes were noted in the speech area (17.2 points to 14.5 points before and after course), socialization (15.8 points and 12.4 points, respectively) and behavior (22.1 points and 18.0 respectively).

Table 2

Changes in speech for patients with autism

Efficacy of rehabilitation	After 1st rehab course, n=36	After last rehab course during 1 year
No improvement / worsened	-	-
Improvement (expressiveness,tempo, more various sound and speech reactions)	60%	44%
Considerable improvement (appearance of new motor functions, next stage of speech development)	37%	50%
Lasting improvement/recovery	3%	6%

Table 3

Distribution of patients with autism according to their intellectual abilities (by Raven test data)

Zones of intellectual development	Amount of patients (%), n=36		
	Before the onset of treatment	After the1st treatment course	Last treatment course
I zone (high norm)	-	-	3±2
II zone (good norm): II + II − At all:	4±2 – 4±2	3±2 12±3 15±4,0*	23±5 11±3 34±6**
III zone (average norm): II + III − At all:	9±3 13±4 22±5	16±4 12±3 28±5	19±4 17±4 36±6
IV zone (intellectual boundary state): IV + IV- At all:	16±4 19±4 35±6	12±3 13±4 26±5*	8±3 5±2 13±4**
V zone (mental defect)	39±6	31±6	14±4**

Notes: * − difference in indicators before and after 1-st treatment course (p<0.05); **− difference in indicators before the treatment and at the end of the last treatment course, for patients treated more than ones (p<0.05).

During evaluation of children with autism by CARS (during the last year of treatment in International Clinic of Rehabilitation) in 62±7% of children we have observed significant or marked improvement, in 30±5% − slight improvement or preservation of light/moderate clinical manifestations, in 10±3% of children − mental state remained without significant changes, severe manifestations of autism remained. In any child dynamics in CARS score didn't show deterioration. In the final evaluation of the overall dynamics of the clinical condition by CARS in 90±9% of children with regular INRS treatments changes in the form of reduction of autistic symptoms were observed.

According to a survey by Raven test before treatment 39±6% of patients with autism were in the area of intellectual defect (V-th area) 35±6% in the area of intellectual boundary condition (IV-th area), 22±5% in zone of average intellectual development (III-rd zone). Good norm (II-nd zone) revealed only in 4±2% of patients, high level of intellectual development in these children was missing. Results of the study of intellectual abilities mostly correlated with clinical and psychopathological findings. They have convincingly shown that cognitive impairment in a child with autism is one of the leading and frequent syndromes in the clinical picture of the disease.

Analysis of the dynamics of the intellectual development by Raven test after the first course of INRS rehabilitation revealed the presence of distinct improvements in intellectual performance. The dynamics of intellectual performance in different clinical groups of children with autism were unidirectional. The most significant positive changes of intellectual development occurred in patients with low performance (after rehabilitation course in the area of in-

tellectual defect left 31±5% of children compared to 39±6% before treatment, in the zone of intellectual boundary condition 26±5% compared to 35±6% before treatment). After repetitve courses of treatment amount of children with normal development of intelligence was 73±8% (before the onset of treatment 26±5%, p<0.01), of which 3±2% with high development of intelligence (zone I). The number of patients with mental defect (V area) after repeated courses of rehabilitation reduced from 39±6% to 14±4% (p <0,05) (Table 3).

Conclusions

The results of research show that after the rehabilitation of children with autism by INRS positive dynamics of motor development is observed, namely muscle tone in the distal parts of lower extremities decreased, the volume of active and passive movements increased, fine hand fuctions improved and new gross motor skills were learned. During rehabilitation communication and scocialization improves, reduction of autistic symptoms is observed, level of cognitive performance increases, significantly increases the number of children with the normative levels of intellectual development. It is noted that the positive dynamics in the formation of speech happens: understanding of spoken language improves, speech tempo increases, dyslalia signs decrease, transition of the child to a higher stage of language development is observed.

Overall, patients after INRS treatment have positive transformation of indicators reflecting the current state of neuropsychiatric, communicative, intellectual and language development. Given the above data, we can conclude that INRS is a modern rehabilitation technology which can be used for treatment of patients with childhood autism.

Limitations. This was a prospective study, there was no control group without randomized allocation or blind testing of participants or examiners.

Disclosure

Examinations of patients were performed by doctors working in International Clinic of Rehabilitation. Institute of medical rehabilitation works on studying ways of influence of INRS. Research support has been done by SI «Institute of neurology, psychiatry and narcology of NAMS of Ukraine», Shupyk National Medical Academy of postgraduate education, Ministry of Health of Ukraine. The authors declare that they have no competing interests.

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Зміни психомоторних показників у дітей з аутизмом при лікуванні за системою інтенсивної нейрофізіологічної реабілітації

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Ціль дослідження. Система інтенсивної нейрофізіологічної реабілітації була створена для лікування дітей з дитячим церебральним паралічем (ДЦП), використовується вже понад 30 років і об'єднує більше десятка різноспрямованих методів

лікування, які потенціюють і доповнюють дію один одного. Численні дослідження змін функціональних можливостей дітей показали, що даний метод має позитивний вплив не тільки на рухові функції, але і на такі функції як пам'ять, увага, інтелект, мова, емоційний стан.

Матеріал і методи. Проспективне дослідження. Обстежено 39 дітей з аутизмом (F84.0), проведений моніторинг в період з жовтня 2015 по жовтень 2016 року.

Для оцінки ефективності реабілітації використані психопатологічний метод, доповнений рейтинговою шкалою дитячого аутизму (CARS), шкалою оцінки ефективності лікування аутизму (ATEC), клініко-неврологічний метод (неврологічний статус, оцінка м'язового тонусу за шкалою Ашворса, гоніометрія) і психодіагностичний метод (кольорові матриці Равена). Також було зроблено відеозапис великих моторних функцій до і після кожного курсу лікування.

Результати. Згідно з отриманими результатами, після реабілітації дітей з аутизмом за СІНР спостерігалися позитивні зміни у моторному розвитку, а саме зниження м'язового тонусу в дистальних відділах нижніх кінцівок у 96±10% пацієнтів, збільшення об'єму активних і пасивних рухів у 92±9%, поліпшення дрібної моторики у 44±6%, поява нових великих моторних функцій в 14±4%. Під час реабілітації у 46±7% хворих спостерігалось покращення комунікативних навичок та соціалізації, зменшення аутистичної симптоматики (в середньому бал за шкалою ATEC склав 66±10 бала до і 51±6 після), кількість дітей з інтелектуальним розвитком в межах нормативних показників значно збільшилась. Позитивну динаміку в формуванні мовленнєвої функції було відзначено у 62±7% пацієнтів: розуміння розмовної мови покращилося, темп мовлення прискорився, симптоми дислалії зменшились, спостерігався перехід на більш високий щабель розвитку мовлення.

Висновок. Під час лікування за СІНР спостерігалася позитивна трансформація паттерну показників, що відображає фактичне покращення нервово-психічного стану, рівня соціалізації, інтелектуального та мовленнєвого розвитку дітей. СІНР може застосовуватись для ефективного лікування пацієнтів з аутизмом через нормалізацію моторного розвитку, комунікативної та інтелектуальної сфери в процесі реабілітації.

Ключові слова: дитячий аутизм, розлад аутичного спектру, СІНР, реабілітація.

Изменение психомоторных показателей у детей с аутизмом при лечении по системе интенсивной нейрофизиологической реабилитации

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Цель исследования. Система интенсивной нейрофизиологической реабилитации была создана для лечения детей с церебральным параличом (ДЦП), используется уже более 30 лет и объединяет более десятка разнонаправленных методов лечения, которые потенцируют и дополняют действие друг друга. Многочисленные исследования изменений функциональных возможностей детей показали, что данный метод оказывает положительное влияние не только на двигательные функции, но и на такие функции как память, внимание, интеллект, речь, эмоциональное состояние.

Материалы и методы. Проспективное исследование. Обследованы 39 детей с аутизмом (F84.0), проведен мониторинг в период с 1995 по 2014 год.

Для оценки эффективности реабилитации использованы психопатологический метод, дополненный рейтинговой шкалой детского аутизма (CARS), шкалой оценки эффективности лечения аутизма (ATEC), клинико-неврологический метод (неврологический статус, оценка мышечного тонуса по шкале Ашворса, гониометрия) и психодиагностический метод (цветные матрицы Равена). Также была сделана видеозапись моторных функций до и после каждого курса лечения.

Результаты. Согласно полученным результатам, после реабилитации детей с аутизмом по СИНР наблюдались положительные изменения в моторном развитии, а именно снижение мышечного тонуса в дистальных отделах нижних конечностей в 96±10% пациентов, увеличение объема активных и пассивных движений в 92±9%, улучшение мелкой моторики в 44±6%, появление новых моторных функций в 14±4%. Во время реабилитации в 46±7% больных наблюдалось улучшение коммуникативных навыков и социализации, уменьшение аутистической симптоматики (в среднем балл по шкале ATEC составил 66±10 балла до и 51±6 после), количество детей с интеллектуальным развитием в пределах нормативных показателей значительно увеличилось. Положительную динамику в формировании речевой функции было отмечено у 62±7% пациентов: понимание разговорной речи улучшилось, темп речи ускорился, симптомы дислалии уменьшились, наблюдался переход на более высокую ступень развития речи.

Заключение. Во время лечения по СИНР наблюдалась положительная трансформация паттерна показателей, что отражает фактическое улучшение нервно-психического состояния, уровня социализации, интеллектуального и речевого развития детей. СИНР может применяться для эффективного лечения пациентов с аутизмом из-за нормализации моторного развития, коммуникативной и интеллектуальной сферы в процессе реабилитации.

Ключевые слова: детский аутизм, расстройство аутистического спектра, СИНР, реабилитация.

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