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Results of osteopathic treatment of infants with psychomotor developmental disorders

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Abstract

Aim. To compare the effectiveness of osteopathic treatment of infants with psychomotor development disorders with standard treatment in terms of functional status.

Methods. The study was conducted at the Yaroslav-the-Wise Novgorod State University and the Institute of Osteopathic Medicine named after V.L. Andrianov, between 2020 and 2021. The study included 49 children with delayed psychomotor development, of which: the main group consisted of 26 children receiving osteopathic treatment; the control group consisted of 23 children treated with standard therapies. Data gathered included the indicators of the functional health state, complaints of parents, assessed neurological, vegetative, and osteopathic statuses, the psychomotor development in the children according to the Zhurba–Mastyukova scale, performed neurosonography. The results were processed using descriptive statistics followed by checking for the significance of the difference by using the Student's t-criterion for related samples.

Results. A comparison of the effectiveness of osteopathic and standard treatment of infants with a delay in psychomotor development by indicators of the functional status was carried out. The need for an integrated approach to therapeutic and diagnostic procedures was substantiated. The number of subjective complaints about the health of children from parents in the main group decreased, while in the control group, it remained the same. Neurological status in children of both groups improved, but the changes are more pronounced in the main group ($p < 0.05$). The outcomes of the treatments indicate for improving psychomotor development of the children in the main group, in the control group, such an increase was only 13.0% ($p < 0.001$).

Conclusion The results of the study showed that osteopathic treatment of infants with psychomotor development disorders is more effective than standard complex treatment, which is reflected in the improvement of functional health indicators.

Keywords: early age, delayed psychomotor development, osteopathic status, osteopathic treatment.

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Background. The timely detection of mental development problems in infants and the subsequent assessment of their psychomotor development represents a significant difficulty for neurologists [1]. The situation can be explained by the specificity of the evolutionary-age characteristics of the developing brain of the child, the immaturity of his developing nervous system, the wide variability of the conventionally normal rates of mental development, and the rough, minor forms of pathology that are registered in postnatal ontogenesis in children. Additionally, the genetic program that underlies the child's psychomotor development is implemented in rapidly changing social and environmental conditions [2]. All of the above requires urgent and thorough neurological examination and in-depth analysis of the infant's neurological status.

Brain lesions at the stage of perinatal development and the consequences they caused represent a topical problem in the research of pediatric neurology during the second decade of the XXI century. In the future, such patients may face various consequences, such as cerebral palsy, mental retardation, epileptic seizures, hydrocephalus, attention deficit hyperactivity disorder, damage to the visual and auditory analyzer, and strabismus, as well as various speech defects [3].

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Hypoxic and ischemic lesions are one of the most significant in a range of damaging factors in the psyche development of children; they can be both independent and induced by infections, trauma, and metabolic disorders. In the formation of the psychomotor development disorders of newborns, a special place is held by mechanical trauma during the birth process, which is sometimes combined with fetal hypoxic conditions [4].

Such trauma is a consequence of tissue damage of a newborn due to effects on his head, cervical region, and other parts of the spine, which impair the strength of blood vessels, brain structures and membranes, nerve roots, and plexuses. Along with the well-known damaging aspects in the biomechanics of natural labor, which include the force of intra-abdominal and intrauterine pressure, the main zones of bone biomechanical disorders have also been determined that influence the successful labor outcomes (functional disorders of the mobility of the sacrum and iliac bones, pubic articulation, and sacral-coccygeal joint). Unprofessional actions of an obstetrician-gynecologist influence an increased degree of trauma during the birth process [5].

In the last two decades, the problem of natal craniocervical trauma has emerged in neurology, which consequences are manifested not only after birth but also in a more remote period. The use of methods for early diagnostics of traumatic injuries of the skull and cervical spine, which are the most significant for the further prognosis of complications, is undoubtedly the basis for combining the capabilities of standard and osteopathic methods of diagnostics and subsequent treatment [6]. The problem of natal cerebrospinal injuries of a newborn can be overcome using an integrated approach to the diagnostics and correction of birth injury consequences [7].

Research results provide evidence that children with varying degrees of central nervous system damage severity at the stage of perinatal development are subject to further neurological disorders have both physical and cognitive retardation and experience difficulties in adaptation and socialization [8]. Neurological lesions account for >50% in the range of general pediatric disability, of which approximately 70%–80% are caused by perinatal lesions [9]. All of the above necessitates early diagnostics and subsequent rehabilitation of such patients.

Children who are diagnosed with even mild perinatal brain damage and minimal neurological abnormalities in the neonatal period are at risk of developing encephalopathy. Researchers assessed the causes of perinatal lesions in newborns and primarily note the hypertensive-hydrocephalic syndrome, which is caused by impaired cerebrospinal fluid circulation, but its timely diagnostics in infants is practically impossible [10].

Osteopathic treatment is the most effective in overcoming the problem of the hypertensive-hydrocephalic syndrome in children under 1 year old, which is confirmed by radiation diagnostic results. The osteopathic method of treatment avoids drug treatment for full-term infants with hypertensive-hydrocephalic syndrome without structural changes in the brain, such as neoplasms, infection and hemorrhage consequences, and brain development abnormalities [11]. In the XXI century, the above is of particular importance due to the increased number of children with allergic reactions, which often precludes from the use of drugs [12].

With perinatal pathology of the central nervous system, a complex of disorders of the cortical-subcortical structures often occurs, which induce an imbalance of autonomic processes. The problem of overcoming the consequences that arise from the central nervous system lesions at the stage of perinatal development remains unresolved. The aspects of the functional state of the organism of infants with psychomotor retardation and methods of correcting their adaptive capabilities have not been adequately investigated, which necessitates the development of rehabilitation treatment programs that are aimed at overcoming functional changes. The problem of assessing the treatment efficiency of infants with psychomotor developmental disorders as an essential aspect in the system of protecting their health and preventing diseases remained controversial [13].

All of the above-mentioned **aimed for** conducting a clinical study to compare the results of the osteopathic and standard treatment of children aged 5–6 months with psychomotor retardation in terms of the functional state of the body.

Materials and methods. The experimental study was conducted in 2020–2021 at the Department of Restorative Medicine and Osteopathy at the Yaroslav the Wise Novgorod State University and the V.L. Andrianov Institute of Osteopathic Medicine. The study involved 49 children aged 5–6 months, distributed into the main group and the control group. The main group was represented by 26 pediatric patients who are diagnosed with psychomotor retardation and were treated using osteopathic techniques. The control group included 23 children with the same diagnosis and was offered standard treatment. The criteria for the inclusion of children in the groups were the age of 5–6 months and the diagnosis of psychomotor retardation. The criterion for exclusion from the main and control groups was the organic pathology of the central nervous and musculoskeletal systems in children.

The entire period of experimental work consisted of four stages (preparatory, organizational, interpretive, and corrective) and lasted for approximately 1 year. Descriptive statistics were used for data processing, with an assessment of significant differences according to the Student's *t*-test for related samples.

The organization of experimental work was approved by the Ethics Committee of the Yaroslav the Wise Novgorod State University (protocol No. 1-2020 dated April 14, 2020).

The anamnestic indicators of the functional state of the body were analyzed in all children, as well as complaints from parents about their mental and physical health; the neurological, vegetative, and osteopathic statuses of children were determined, psychomotor development was assessed using the Zhurba–Mastyukova scale and neurosonographic data of the study participants were obtained.

As for indicators of the functional state of the child's body, we considered the parents' complaints about his health, the data of the cardiovascular and respiratory system assessment, and the results of the neurological, autonomic, and osteopathic statuses assessment, as well as neurosonography data.

The neurological status of the child was revealed as a result of his examination. The status was determined by several parameters, namely the state of motor activity, muscle tone in the limbs during movements; the presence and severity of unconditioned and tendon reflexes, visual, and auditory reactions; and the state of motor skills. Additionally, the list of parameters included the results of measuring the head circumference, the size of the anterior fontanelle and cranial sutures; presence/absence of pathological ocular signs (e.g., strabismus, anisocoria, asymmetry of the palpebral fissures, nystagmus, and Graefe syndrome); and the state of emotional reactions and pre-verbal development (child's talk and babbling).

The initial vegetative tone of the child was determined according to the A.M. Wayne tables adapted for early and infantile age, which correlated the assessments of sympathetic and parasympathetic signs [14].

Blood pressure, respiratory rate, and heart rate were assessed to evaluate the state of the cardiovascular and respiratory systems.

The osteopathic status of the child was assessed before and after treatment. Osteopathic diagnostics was performed according to the generally accepted methods [5]. First of all, the state of the craniosacral system was assessed. The cranial rhythmic impulse from the side of the skull and sacrum was tested, and the state of the reciprocal tension membranes (dural reflections) and the position and mobility of the sphenobasilar synchondrosis were analyzed. Additionally, barriers have been diagnosed that limit the mobility of the craniosacral mechanism and cause compression problems of the sacroiliac joint, as well as L_5–S_1 and C_0–C_1 segments. The synchronized movement of the three diaphragms and the severity of intraosseous injuries to the skull and sacral bones were also assessed.

The follow-up scale of L.T. Zhurba and E.M. Mastyukova was used to assess the level of psychomotor development of children [2].

Neurosonography was used as an additional method, which is an ultrasound transfontanellar selective scan of the brain using the Sonomed-400 ultrasound scanner.

Osteopathic treatment consisted of 4–6 sessions, 20–25 min each (the interval between sessions was 2 weeks), and included the following components:

1) correction of the occipital bone intraosseous injuries (technique of scale derotation, lateral mass decompression, and correction of the supra- and suboccipital parts at the level of the posterior intraoccipital synchondrosis);

2) balancing the dura mater (techniques for balancing the skull and sacrum and modeling the skull);

3) correction of sphenobasilar synchondrosis compression (technique of sphenobasilar synchondrosis decompression by approach through the fornix);

4) hemo-cerebrospinal fluid circulation restoration (V. Frymann method of venous sinuses and method of alternating rolling of the temporal bones);

5) correction of dysfunctions at the level of segments C_0–C_1, C_7–Th_1, L_5–S_1, and sacroiliac joint; correction of pelvic and abdominal diaphragm dysfunctions.

The standard treatment regimen consisted of drug therapy (nootropic and vasoactive drugs), physical therapy according to age, and physiotherapy.

The treatment efficiency was assessed by comparing the indicators of the functional state of the child's body, namely the number of parents' complaints about his health, the cardiovascular and respiratory systems assessment data, the neurological, autonomic, and osteopathic statuses evaluation results, and neurosonography data. Methods of descriptive statistics were used for data processing, with an assessment of significant differences according to the Student's *t*-test for related samples.

Results and discussion. The analysis of the parents' complaints about the functional state of

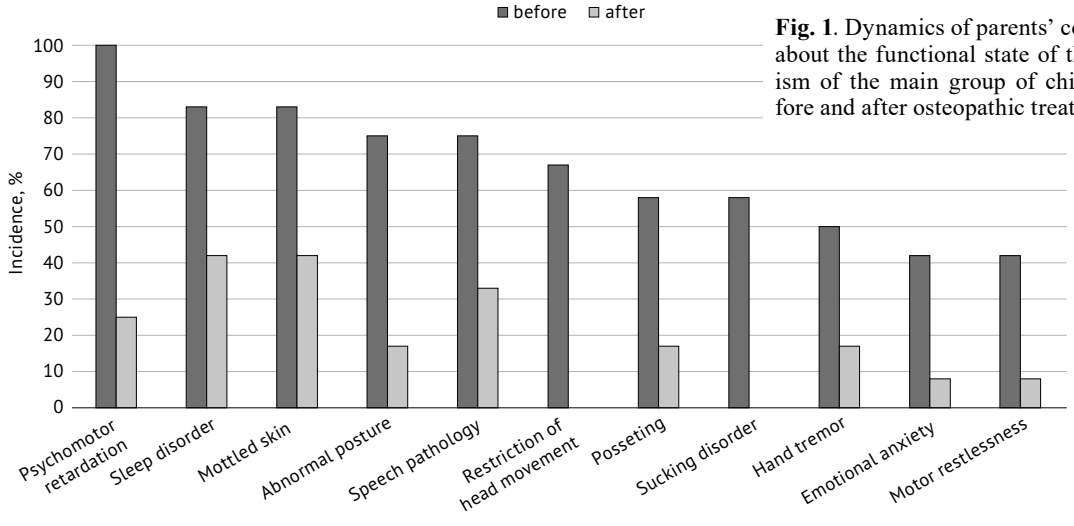

Fig. 1. Dynamics of parents' complaints about the functional state of the organism of the main group of children before and after osteopathic treatment.

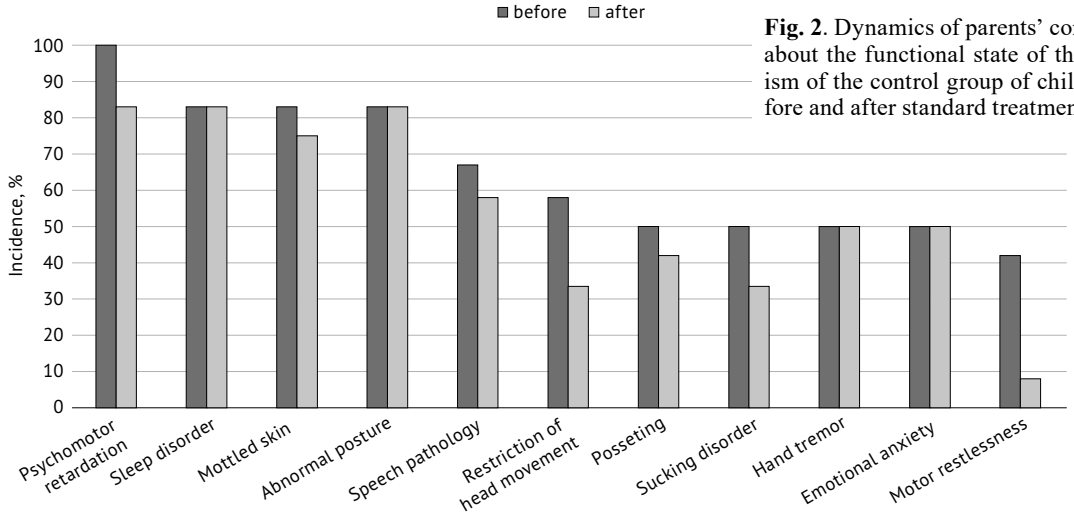

Fig. 2. Dynamics of parents' complaints about the functional state of the organism of the control group of children before and after standard treatment.

the child's body revealed various manifestations of somatic dysfunctions. Parents of children of both the main and control groups complained of psychomotor retardation of infants (100%), their sleep disorders (83%), mottled skin (83%), the abnormal posture of the child (75%), lack of child's talk (71%), and somewhat less often, on the installation position of the head (63%), and posseting and sucking disorder (54%), as well as motor restlessness (46%) and emotional anxiety (42%). This is a set of complaints from parents on the functional health of children from the main and control groups.

After osteopathic treatment of the main group of pediatric patients, the percentage of the number of complaints from parents on the functional state of the body of infants decreased. The number of parents' complaints about the psychomotor retardation of infants decreased (25%), as well as their sleep disorder (42%), mottled skin (42%), and abnormal posture (17%). According to the parents, their children began to poise their heads better, their problems with sucking disappeared, and they started to show less emotional and motor anxiety ($p > 0.05$). Fig. 1 presents the study results.

After the standard allopathic treatment, a decreased frequency of complaints was noted from the parents of the control group of children in impaired sucking (by 1.5 times) and a limitation in the volume of their active head movements (by 1.8 times); however, the main complaints remained without significant changes ($p < 0.05$%). These results are presented in Fig. 2.

The diagnostics according to the L.T. Zhurba and E.M. Mastyukova follow-up scale detected psychomotor retardation in all children of the main and control groups. Thus, 5 (19%) children of the main group and 6 (26%) of the control group entered the risk group for developmental delays, and developmental delay was established in 21 (81%) children of the main group and 17 (74%) children of the control group. The osteopathic treatment promoted an increased level of psychomotor development in all children of the main group, whereas this increase was 13.0% in children receiving stan-

Table 1. Changes of psychomotor development over time in children of the study and control groups before and after treatment (%).

Indicators		Before treatment	After treatment	p
Main group (n = 26)	Normal development	0	77.0	<0.001
	Risk group	19.2	19.2	>0.05
	Developmental retardation	80.8	3.8	<0.001
Control group (n = 23)	Normal development	0	13.0	>0.05
	Risk group	21.1	34.8	>0.05
	Developmental retardation	73.9	52.2	>0.05

Table 2. Changes of neurological disorders over time in children of the study and control groups before and after treatment (%).

Indicators		Before treatment	After treatment	p
Main group (n = 26)	Pyramidal syndrome	73.1	42.3	<0.05
	Muscular dystonia	57.8	26.9	<0.05
	Muscular hypotension	50.0	34.6	>0.05
Control group (n = 23)	Pyramidal syndrome	78.3	69.6	>0.05
	Muscular dystonia	56.5	52.2	>0.05
	Muscular hypotension	60.7	43.5	>0.05

dard allopathic treatment ($p < 0.001$) in the entire sample of the control group. The results are presented in Table 1.

Neurological examination of children of the main and control groups revealed increased neuroreflectory excitability as manifested in the form of shudder, muscle tone dystonia, tremor of the chin and limbs, and increased reflexes.

The syndrome of neuroreflectory excitability was diagnosed in 19 (73%) and 18 (78%) respondents of the main and control groups, respectively ($p > 0.05$).

Four (15%) and three (13%) respondents from the main and control groups, respectively, were diagnosed with the hypertensive-hydrocephalic syndrome, which symptoms were manifested in the dehiscence of the cranial sutures and tension of the anterior fontanel, general motor and emotional anxiety of children, and sleep disorder ($p > 0.05$).

Suppression syndrome was also diagnosed in 13 (50%) and 14 (60%) respondents, respectively, from the main and control groups, which manifested itself in sluggish sucking, hypodynamia, muscle hypotension, and hyporeflexia ($p > 0.05$).

The study results revealed that after the treatment, the neurological status indicators improved in the groups of children. However, favorable changes were more pronounced in the main group of respondents during the osteopathic correction, which is presented in Table 2.

The most pronounced clinical manifestations of the vegetative status in children in the study groups before treatment were skin pallor, restlessness, persistent sucking, crying during an examination, and repeated posseting. After the osteopathic correction, the respondents of the main group noted a decrease in all clinical manifestations, posseting persisted in only 1 child, and motor restlessness while examination of the children decreased. In the control group, almost all clinical manifestations remained unchanged.

The evaluation of the functional parameters of the cardiovascular and respiratory systems (blood pressure, heart rate, and respiratory rate) revealed that the respondents of both groups have indicators that exceeded age norms. The analysis of the initial vegetative status of children in both groups showed the presence of arterial hypertension in 67% and 58% of cases, respectively; pronounced signs of tachycardia were detected in 67% of children in the main group and 58% in the control group. Tachypnea was registered in 58% of cases in patients of both the main and control groups. All the revealed indicators indicate the tone of the sympathetic nervous system and the tension of adaptation processes, although a state of relative vagotonia is more typical for infants.

After the osteopathic treatment, the indicators of the functional state of the organism of the main group changed toward a positive direction, particularly, the severity of sympathicotonia and adaptation processes decreased ($p < 0.05\%$). The results are presented in Table 3.

In the control group, during the allopathic treatment, the autonomic nervous system tension was

Table 3. Functional parameters of the organism in the main group before and after treatment, %.

Indicators	Before treatment	After treatment	p
Tachycardia	67.0	25.0	<0.05
Bradycardia	33.0	17.0	>0.05
Tachypnea	58.0	33.0	>0.05
Bradypnea	42.0	25.0	>0.05
Muscular hypertension	67.0	25.0	<0.05
Muscle hypotension	33.0	17.0	>0.05

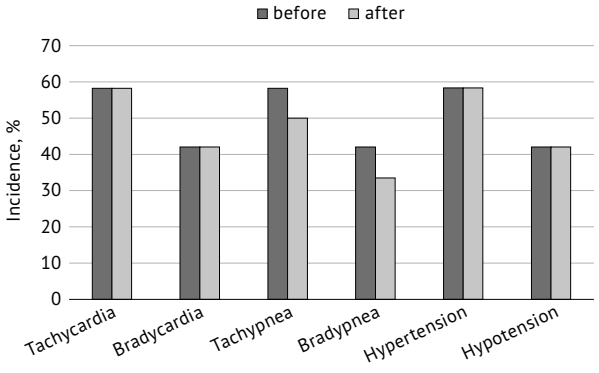

Fig. 3. Functional state indicators of the body of the control group before and after standard treatment.

retained with a predominance of sympathicotonia, which is illustrated in Fig. 3.

Osteopathic examination revealed signs of natal trauma in 100% of children of both groups, which manifested itself as a craniosacral mechanism dysfunction. The main osteopathic dysfunctions in children of the studied groups included sphenobasilar synchondrosis compression (100%), craniosacral asynchronism (100%), thoracoabdominal diaphragm (88%), C_0–C_1 (83%), C_7–Th_1 (75%), and pelvic diaphragm dysfunctions (71%), intraosseous damage to the occipital bone (63%), and C_1–C_2 dysfunction (63%).

After treatment, children of both groups showed improved parameters compared to the baseline data, and changes were more significant in the main group. Thus, after the treatment, the respondents of the main group had a 12-fold decreased indices of sphenobasilar synchondrosis dysfunctions ($p < 0.001$), that of C_1–C_2 by 8 times ($p < 0.01$), and intraosseous injuries of the occipital bone and C_0–C_1 dysfunctions decreased by 4.5 times ($p < 0.01$). In the control group, after the allopathic treatment, a decreased indices of dysfunctions of the thoracoabdominal and pelvic diaphragms by 1.3–1.4 times ($p > 0.05$), as well as dysfunctions of C_1–C_2, C_0–C_1, and C_7–Th_1 by 1.1–1.2 times were recorded ($p > 0.05$). Most of the dysfunctions remained unchanged ($p > 0.05$).

The neurosonography that was performed before the treatment revealed enlargement of the interhemispheric fissure and subarachnoid spaces in 42% of all respondents, and the size of the lateral ventricles was significantly increased in 58% of children. After the osteopathic treatment, neurosonography showed preservation of only the lateral ventricle dilatation in 25% of the respondents of the main group, and 8.3% of children had the expansion of the external cerebrospinal fluid spaces, without expansion of the interhemispheric fissure. In the control group, these signs remained unchanged.

CONCLUSIONS

1. After the osteopathic treatment, the respondents of the main group improved the functional state indicators of the organism, the level of psychomotor development increased, the clinical manifestations of autonomic disorders decreased, and the values of the craniosacral mechanism and the indices of neurosonography decreased. After the standard treatment, a significant part of the dysfunctions remained unchanged in the control group.

2. Osteopathic treatment of young children with psychomotor retardation is more effective in terms of the functional state of their body in comparison with standard treatment.

Author contributions. V.R.V. was the work supervisor; I.A.E. performed diagnostics and osteopathic correction; E.R.Z. generalized the research materials and performed stylistic processing of the article content; A.E.Ch. collected the information, interpreted, and performed mathematical processing of the research results.

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