AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

# FEATURES OF THE FUNCTIONAL STATE OF THE CENTRAL NERVOUS SYSTEM IN CHILDREN WITH POST-TRAUMATIC ENCEPHALOPATHY

***Nasirova Dilfuza Shavkatovna***
*Tashkent State Medical University*

**Abstract:** Post-traumatic encephalopathy (PTE) in children is a common and poorly understood consequence of mild to moderate traumatic brain injury (TBI). Despite the subtle clinical manifestations in the acute phase, persistent cognitive, autonomic, and neurophysiological impairments can develop in the late phase of PTE.

This study presents data from a comprehensive clinical, neurological, neuropsychological, and in strumental examination of 46 children aged 7 to 18 years who had suffered a concussion (Group A, n=20) or brain contusion (Group B, n=26). An analysis of complaints, headache severity usin g the Visual Analog Scale (VAS), clinical neurostatus, and the functional state of the autonomic nervous system (Guillaume-Vein scale), as well as EEG and MRI results, was conducted. The primary complaint in most chil dren was tension-type headache of moderate intensity.

## Introduction

Traumatic brain injury (TBI) in children occupies a leading place in the structure of acute neurological conditions, often causing late consequences that lead to a decrease in cognitive potential, social maladjustment and impaired quality of life in adolescence and adulthood [1, 15]. Notwithstanding the fact that the most common forms of TBI in childhood are concussion and brain contusion, they often remain underestimated in clinical practice, especially in the late phase [2, 3, 16, 24, 25]. Post-traumatic encephalopathy (PTE), developing as a result of these conditions, is manifested by a variety of symptoms, including headaches, autonomic lability, emotional disturbances and cognitive deficits [5, 6, 7, 8, 9, 10, 11, 12]. However, the lack of a standardized approach to the comprehensive assessment of such patients, as well as insufficient integration of objective neurophysiological methods, complicate timely diagnosis and the choice of a route for observation and correction [15, 18, 22].

Contemporary research indicates a close relationship between the functional state of the brain (based on EEG data), clinical neurological status, and neuropsychological testing results in children with posttraumatic stress disorder [4]. However, most studies focus on individual aspects (e.g., posttraumatic headache or anxiety), while a comprehensive approach that includes clinical, behavioral, and instrumental parameters remains underdeveloped [13]. The problem of assessing children who have suffered mild to moderate TBI is particularly pressing, as they often exhibit delayed and subclinical disorders that are only detected during targeted examination [14].

In recent years, there has been growing interest in developing digital patient profiling models for the purposes of risk stratification, routing, and monitoring the effectiveness of rehabilitation measures [19, 23]. In conditions of limited access to expensive imaging methods, the use of routine electroencephalography in combination with validated age-adapted scales and tests is particularly valuable. The creation of a visual cognitive-neurophysiological profile of a patient, combining neuropsychological, behavioral, and digital EEG indicators, opens up opportunities for standardizing the approach to diagnosis and assessing the dynamics of the condition.

Thus, this study aims to develop and test a unified scheme for the comprehensive assessment of children with post-traumatic encephalopathy who have suffered a concussion or brain injury,

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

followed by visualization of their individual neurocognitive profile and identification of the most significant clinical and physiological correlates.

**Materials and methods of research**

The study included 46 children aged 7 to 18 years who had suffered mild to moderate traumatic brain injury (concussion and brain contusion). All patients were observed as outpatients or were undergoing rehabilitation treatment at a specialized medical facility. The study was divided by injury type: Group A included children with concussion (n=20), Group B included children with brain contusion (n=26). Inclusion criteria were: confirmed mild to moderate TBI, no organic CNS disease, no history of intellectual disabilities, no significant psychoemotional disorders, and no use of psychotropic therapy within three months prior to the examination. All patients and their legal representatives provided written informed consent to participate in the study.

The examination was conducted between one and six months after the TBI, with the mandatory participation of a neurologist and psychologist. The examination included:

Analysis of complaints and clinical status, including an assessment of: headache severity using the Visual Analog Scale (VAS) (0–10 points); autonomic dysfunction using the Guillaume–Vein Autonomic Dysfunction Scale (GAS) with a point index (0–30); behavioral characteristics and emotional background using an adapted questionnaire based on the CBCL and the STAI-C anxiety scale (for children under 15 years old) or HADS (for adolescents over 15 years old); sleep quality using a questionnaire with elements of the Children's Sleep Habits Questionnaire (CSHQ).

Neuropsychological testing, including: the MoCA (Child Adaptation Assessment) scale for screening cognitive functions; the Luria 10-Word Test (memory assessment); the Luria Kinetic and Dynamic Praxis Test; Digit Span (digital series) — assessment of attention and working memory; the Concept Classification Test — abstract thinking.

Neurophysiological examination: – routine EEG at rest with closed and open eyes, with assessment of background activity, dominant rhythm, frequency indices, presence of theta, delta and paroxysmal activity, interhemispheric asymmetry; digital EEG analysis with calculation of alpha-peak frequency, theta/beta ratio (TBR), EEG dysfunction index (0–10 points); MRI of the brain (n=16) was performed according to indications: persistent headache, severe cognitive impairment or paroxysmal activity on EEG.

Based on the collected data, an individual cognitive-neurophysiological profile was created for each patient, integrating quantitative and qualitative indicators of neuropsychological testing, behavioral status, autonomic regulation, and digital EEG parameters. The results were visualized as a spider diagram (radar graph), allowing for standardized presentation of the patient's status and the use of the profile over time.

Statistical data processing was performed using Microsoft Excel and SPSS 22.0. Descriptive statistics, comparative analysis (Student's t-test, $\chi^2$-test), and correlation analysis (Spearman's rho coefficient) were used. Differences were considered statistically significant at $p < 0.05$.

**Research results**

*Descriptive characteristics of the examined patients*

The study included 46 children (24 girls and 22 boys) aged 7 to 18 years. The average age of the subjects was 12.7 ± 3.2 years. Age at the time of traumatic brain injury ranged from 5 to 17 years, with an average of 10.0 ± 2.9 years. The time interval from the injury to the examination ranged from 1 to 6 years (average 3.1 ± 1.5 years).

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

Based on clinical diagnosis, patients were divided into two groups: Group A (n=20, 43.5%) — children diagnosed with concussion; Group B (n=26, 56.5%) — children diagnosed with brain contusion.

Among children with brain contusions, mild forms were the most common (n=17; 65.4%), although nine cases (34.6%) had moderate-severity clinical presentations. In the concussion group, all cases were classified as mild TBI. No concussion patient had a history of loss of consciousness, while four children (15.4%) in the concussion group experienced a brief loss of consciousness (up to 30 minutes). The remaining concussion cases (n=22) did not involve loss of consciousness but were accompanied by vestibular, coordination, or behavioral disorders in the early post-traumatic period.

*Primary Patient Complaints*

Analysis of the complaints revealed that the most common symptoms in the children examined were headaches, increased fatigue, decreased concentration, emotional instability, and sleep disturbances. The frequency and severity of complaints were significantly higher in the group of patients who had suffered a brain contusion compared to children after a concussion.

Headache was reported in 39 children (84.8%), with its nature and intensity varying depending on the severity of the injury and the time since the TBI. In the concussion group, tension-type headaches of moderate intensity (VAS score 3-5) were prevalent, occurring primarily in the evening or after mental exertion. In the brain contusion group, the majority of patients (65.4%) experienced throbbing or bursting headaches, accompanied by photophobia, nausea, or autonomic symptoms. The mean VAS score in children with concussion was 6.1 ± 1.4 versus 4.3 ± 1.2 in the concussion group ($p < 0.01$). When comparing headache severity with the time since the injury, a pattern emerged: children examined within the first year after TBI had significantly higher pain intensity than those observed longer. Some children who had sustained TBI more than three years previously continued to experience occasional headaches related to weather changes or stress, but their intensity decreased to 2-4 points on the Visual Analog Scale (VAS).

Autonomic dysfunction, as measured by the Guillaume-Vein Autonomic Dysfunction Scale (GVAS), also showed a correlation with the time since the injury. The highest autonomic index values were recorded in the first 6-18 months after TBI (mean 17.2 ± 3.9 points), subsequently decreasing to 11.3 ± 3.1 in children examined 3-5 years later. Persistent persistence of pronounced vegetative symptoms more than 2 years after injury was typical for children with impaired adherence to rehabilitation measures or with concomitant emotional disorders.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

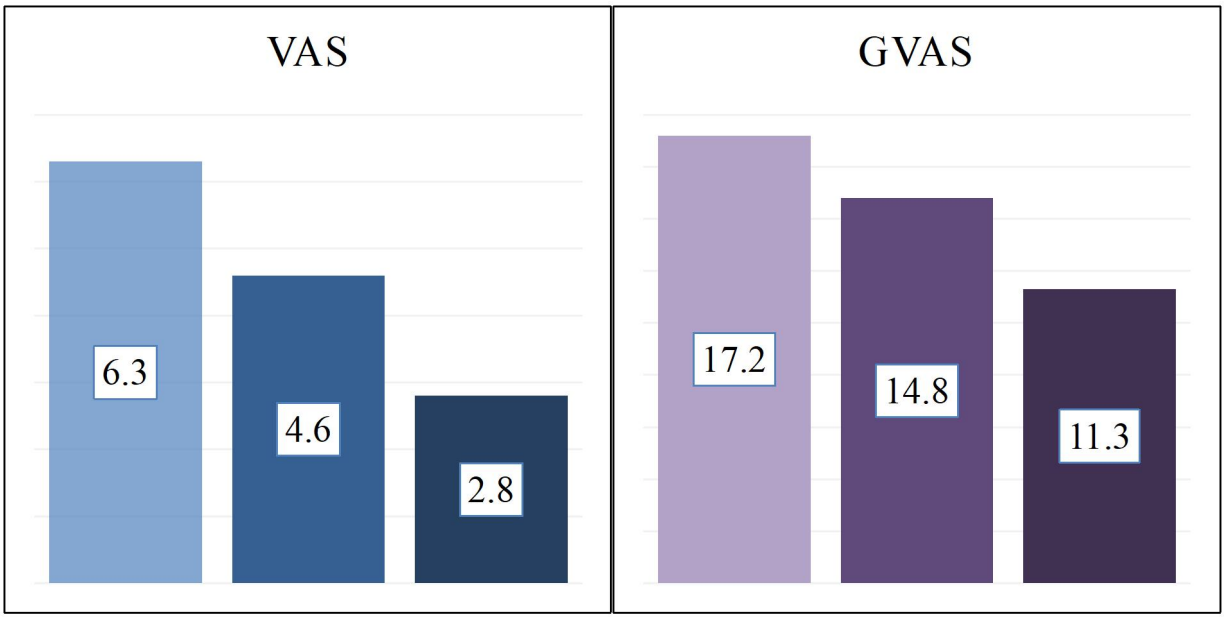


**Fig 1. Severity of headache and autonomic dysfunction depending on duration**

Thus, both the severity of the injury and the time elapsed since the injury influenced the clinical picture. More pronounced somatic, pain, and autonomic symptoms were observed in the subacute and early chronic periods, especially in children with brain contusion.

*Characteristics of Neuropsychological Functions*

Neuropsychological testing revealed a wide range of cognitive impairments in children with PTE, including decreased attention span and short-term memory, slowed verbal and visual-spatial thinking, and elements of praxis impairment. The severity of impairments varied depending on the nature of the TBI.

According to the MoCA (Model of Concussion Assessment for Children) scale, the average score in the concussion group was 25.6 ± 1.9, approaching the lower limit of normal. In the brain contusion group, the average score was significantly lower—22.1 ± 2.7 ($p < 0.01$), consistent with signs of moderate cognitive dysfunction. In 14 children in this group (53.8%), the MoCA score was below the cutoff of 24 points, including 6 patients below 20.

The Luria 10-Word Test, which measures short-term and delayed memory, revealed a significant decrease in the number of words recalled in both groups compared to the age norm. The average score in Group A was 6.4 ± 1.2, while in Group B it was 4.9 ± 1.6 ($p < 0.05$). Nine children in the concussion group remembered fewer than 4 words even after 3 repetitions, which was interpreted as a significant impairment in verbal memory.

Attentional performance, assessed using the Digit Span, was also impaired in most children. In the concussion group, the average number of correctly reproduced digits forward was 5.1 ± 0.7, and backward was 3.2 ± 0.5. In the concussion group, these values were lower: 4.4 ± 0.8 and 2.7 ± 0.6, respectively ($p < 0.05$).

In the dynamic and kinetic praxis tests (Luria exercises), Group B significantly more often reported difficulty switching, perseveration, and fragmented task performance. Violations in the classification of concepts (errors in logical-semantic grouping) were identified in 38.5% of cases in the group with a bruise versus 15% in the group with a concussion.

**Table 1**

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

**Comparative table of neuropsychological indicators**

| Indicator | Concussion | Contusion | p |
|---|---|---|---|
| MoCA (scores) | 25,6 ± 1,9 | 22,1 ± 2,7 | <0,01 |
| 10 words (average) | 6,4 ± 1,2 | 4,9 ± 1,6 | <0,05 |
| Digit Span forward | 5,1 ± 0,7 | 4,4 ± 0,8 | <0,05 |
| Digit Span backward | 3,2 ± 0,5 | 2,7 ± 0,6 | <0,05 |
| Errors in praxis (Luria) | 20% | 46% | <0,05 |
| Errors in concept classifications (%) | 15% | 38,5% | <0,05 |

An analysis of the relationship between the severity of cognitive impairment and the time elapsed since the TBI revealed that cognitive indicators gradually improve with increasing time since the injury. In children examined within the first year after the injury, the average MoCA score was 22.0, the 10-Word Test score was 4.6, and the Digit Span (backward) score was 2.6. Between 1 and 3 years, scores were higher: MoCA 24.0, 10-Word Test score 5.9, and Digit Span score 3.0. The highest scores were observed in children with a TBI duration of more than 3 years: MoCA 26.2, 10-Word Test score 6.8, and Digit Span score 3.5. However, in some patients, cognitive impairment persisted even after 3–5 years, especially in the presence of concomitant autonomic disorders and poor adherence to rehabilitation. Thus, neuropsychological disorders in children with PTE vary in depth and structure, reliably correlate with the severity of TBI and the time elapsed since the injury, and are also associated with clinical and autonomic complaints.

*Instrumental Research Methods*

Routine EEG was performed on all 46 patients while they were awake, recording background activity, the activation response, and standard provocations. The majority of children (63.0%) showed signs of diffuse cerebral dysfunction of varying severity. Alpha rhythm hypersynchronization was observed in 32.6% of cases, while theta activity at rest, including frontal predominance, was observed in 26.1%. Episodes of paroxysmal activity, primarily sharp waves and spikes in the parietal-temporal regions, were detected in 17 patients (36.9%), without clinical signs of epilepsy. Single spike-and-wave complexes were recorded in 3 patients. Digital EEG analysis revealed a decrease in the frequency of the dominant alpha rhythm to 8.2 ± 0.7 Hz in the contusion group versus 9.1 ± 0.5 Hz in the concussion group. The mean theta/beta ratio (TBR) in the frontal leads was 3.2 ± 0.9 in group B and 2.4 ± 0.7 in group A, indicating a relative predominance of slow-wave activity in patients with more severe injuries. The EEG dysfunction index, calculated based on the sum of abnormalities (background activity, asymmetry, paroxysms, slowing), was significantly higher in children with brain contusion (6.3 ± 1.5 points) compared to children after concussion (3.8 ± 1.1 points, $p < 0.01$).

**Table 2**
**EEG Parameters in Patients with Concussion and Brain Contusion**

| № | Parameter | Concussion | Contusion | p |
|---|---|---|---|---|
| 1 | Alpha rhythm frequency (Hz) | 9.1 ± 0.5 | 8.2 ± 0.7 | <0.01 |
| 2 | Theta/Beta Ratio (frontal leads) | 2.4 ± 0.7 | 3.2 ± 0.9 | <0.05 |
| 3 | EEG dysfunction index (0–10 points) | 3.8 ± 1.1 | 6.3 ± 1.5 | <0.01 |
| 4 | Paroxsyzmal frequency (%) | 15% | 38% | <0.05 |

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

| | | | | |
|---|---|---|---|---|
| 5 | Rhythm slowing frequency (%) | 20% | 42% | <0.05 |

Brain MRI was performed in 16 children (34.8%) for clinical indications. Nine cases (56.3%) showed signs of residual post-traumatic changes: slight expansion of the subarachnoid space, localized glial transformation of brain tissue, and signs of intracranial hypertension (ventricular dilation, flattening of the sulci). In two children with severe autonomic dysfunction and persistent cognitive complaints, isolated areas of periventricular leukoareation without demyelination were detected. The remaining patients (43.7%) showed no abnormalities in MRI data.

Thus, neurophysiological examination confirms the presence of functional disturbances in the regulation of bioelectrical activity in children with post-traumatic encephalopathy. More pronounced EEG changes and the frequency of structural MRI findings correlated with the severity of the injury, the presence of autonomic disturbances, and a decline in cognitive performance.

**Discussion**

The results of this study confirm the clinical and neurophysiological significance of the consequences of mild to moderate traumatic brain injury in children. The identified cognitive, behavioral, and autonomic impairments, as well as functional changes based on EEG data, indicate persistent post-traumatic stress disorder, often persisting years after the injury.

The greatest differences between the groups of patients with concussion and brain contusion were observed in the structure of complaints and the severity of symptoms. Tension-type headache was predominant in patients with concussion, while pain and autonomic symptoms were more pronounced in the concussion group. This is confirmed by the VAS scale and the autonomic index (AISI), where differences between the groups reached statistical significance. These findings are consistent with the results of several other studies indicating a high level of somatization and autonomic dysregulation in children after TBI [2, 3, 12].

Neuropsychological assessment revealed impairments in memory, attention, and praxis, particularly in patients with brain contusion. The level of cognitive dysfunction decreased with increasing time since injury, reflecting partial recovery of neurocognitive functions.However, even after 3–5 years, persistent impairments persisted in some patients, particularly in the presence of clinically significant autonomic dysfunction and the absence of systemic rehabilitation [7, 9, 17].

EEG data are of particular interest. A decrease in alpha rhythm, an increase in TBR, and an increase in the EEG dysfunction index clearly correlated with injury severity and cognitive deficits.These results confirm the functional vulnerability of the frontoparietal lobes in children with posttraumatic encephalopathy and highlight the importance of digital EEG analysis in neurological risk stratification. Similar trends were noted in other studies [20, 21], where the use of quantitative EEG indicators increased the diagnostic value of routine EEG.

Despite the limited number of patients who underwent MRI, the detected changes (subarachnoid space expansion, signs of intracranial hypertension, areas of gliosis) complement the picture of functional and structural vulnerability of the brain in the late post-traumatic period [4, 12]. Moreover, the majority of children without MRI abnormalities still showed significant cognitive

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

and autonomic impairments, emphasizing the need to assess functional parameters, not just anatomical ones [14].

The developed model of a visual cognitive-neurophysiological profile has demonstrated high clinical applicability: it allows for the rapid identification of key disorders, monitoring the dynamics of the patient's condition, and developing a personalized rehabilitation route. The integration of digital EEG parameters, neuropsychological assessment, and complaint scales makes the approach reproducible both in specialized care settings and at the general practitioner level.

*Patient stratification and routing.*
The obtained results allowed us not only to identify the leading symptoms and neurophysiological disorders in children with post-traumatic encephalopathy but also to propose a basis for functional stratification of patients aimed at early identification of risk groups and determination of optimal management tactics.

Stratification criteria included:

Clinical and functional parameters: - Headache severity (VAS ≥ 6 points);

- Complaint index ≥ 6;

- Level of autonomic dysfunction (SVSV ≥ 15);

- Emotional lability (STAI / HADS).

Neuropsychological indicators: - MoCA < 24 points;

- "10 words" < 5;

- Digit Span back < 3.

Neurophysiological markers: - Alpha rhythm < 8. 5 Hz;

- TBR > 3. 0;

– EEG dysfunction index > 5 points;

– presence of paroxysms or theta dominance.

Based on the combination of these parameters, patients were conditionally divided into three groups:
Low-risk group: clinical manifestations are minimal, cognitive and EEG profiles are close to normal, and the dynamics are positive; observation as part of a general clinical observation and periodic neuropsychological monitoring are indicated.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

Moderate-risk group: isolated cognitive or autonomic disorders, EEG changes, decreased attention or memory are observed; involvement of a neuropsychologist and neurologist, and correctional programs are required.
High-risk group: multiple complaints, severe cognitive deficits, emotional and autonomic disorders, persistent EEG abnormalities and/or MRI signs; interdisciplinary monitoring (neurologist, psychologist, psychotherapist), advanced diagnostics, and active correction are recommended.

Routing algorithm:
Initial screening (neurologist/pediatrician): – anamnesis, VAS scale, complaints, WMH, MoCA (rapid screening), EEG.
Development of a visual cognitive-neurophysiological profile: - automated calculations and clear visualization (diagram);
- patient stratification based on the sum of criteria.
Pathway determination: - for risk scores of 1–2 — observation and recommendations;
- for scores of 3–5 — specialist involvement, dynamic observation;
- for scores of ≥6 — extensive examination, multidisciplinary approach.
This approach optimizes the care of children with PTE, minimizes prolonged underdiagnosis, and ensures targeted correction of disorders.

**Conclusions**

Posttraumatic encephalopathy in children who have suffered a concussion or brain contusion is characterized by multifaceted disorders: pain, cognitive, autonomic, and neurophysiological. Even mild forms of TBI can lead to persistent changes detectable months and years after the injury. Children with brain contusion are significantly more likely to present with multiple complaints, including severe headaches, symptoms of autonomic dysfunction, memory and attention deficits, and EEG changes. Cognitive testing scores (MoCA, 10-word test, Digit Span) and digital EEG parameters (alpha rhythm, TBR, dysfunction index) demonstrate significant differences between groups. The severity of impairments inversely correlates with the duration of the injury; however, in some cases, residual deficits persist, especially in those with poor rehabilitation adherence and the presence of multiple clinical and functional abnormalities. Routine EEG examination, supplemented with digital parameters (alpha peak, TBR, dysfunction index), has high diagnostic value in assessing the functional state of the brain in the late post-traumatic period. A visual cognitive-neurophysiological patient profile has been developed, integrating neuropsychological, clinical, and digital EEG parameters. This tool allows for standardized assessment of a child's condition, dynamic monitoring, and improved clinical diagnostic accuracy. A functional stratification model and routing algorithm based on a combination of clinical, neuropsychological, and neurophysiological criteria have been proposed. This enables a targeted approach to patient care and optimizes the allocation of healthcare resources.

**LITERATURE**

1. Abdullaev D. D., Tozhiev M. T., et al. Features of the clinical course and diagnosis of acute traumatic brain injury in children // Bulletin of emergency medicine. - Tashkent, 2014. - N2. - P. 35-36.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

2. Artaryan A. A., Iova A. S., Garmashov Yu. A., Banin A. V. Traumatic brain injury in children // Traumatic brain injury: clinical guidelines / edited by A. N. Konovalov, L. B. Likhterman, A. A. Potapov. Moscow: Antidor, 2001. Vol. 2. P. 603–648.
3. Asilbekov U. E. Clinical presentation, diagnosis, and outcomes of severe traumatic brain injury in children of different age groups // Neurosurgery and neurology of Kazakhstan. 2012. No. 1 (26). P. 12–16.
4. Bogolepova A. N., Chukanova E. I. The problem of neuroplasticity in neurology. S. S. Korsakov Journal of Neurology and Psychiatry. 2010; 110 (8): 62–65.
5. Vizilo, T. L. Traumatic encephalopathy: clinical presentation and treatment / T. L. Vizilo, I. V. Vlasova, E. N. Kharkova. // Attending physician. - 2016. - No. 5. - P. 28–32
6. Vorobyova O. V., Vein A. M. Post-traumatic headaches. Consilium medicum. 1999; 1 (2): 73–75.
7. Glushchenko V. V., Shabanov P. D. Minimal brain dysfunction. Moscow: Binom; 2013.
8. Goryunova A. V. Post-traumatic headache in children. Korsakov Journal of Neurology and Psychiatry. 2009; 109 (12): 55-59.
9. Zavadenko N. N., Guzilova L. S., Iznak A. F., Iznak E. V. Consequences of severe traumatic brain injury in adolescents: features of clinical manifestations and treatment. Issues of modern pediatrics. 2010; 9 (4): 57-67.
10. Zavadenko N. N., Kemalov A. I. Consequences of severe traumatic brain injury in children and their treatment. Issues of modern pediatrics. 2006;5(4):14-21.
11. Zavadenko N.N., Nemkova S.A. Developmental Disorders and Cognitive Dysfunctions in Children with Nervous System Diseases. Scientific and Practical Guide. Moscow: MK; 2016.
12. Kemalov A.I. Brain Dysfunctions in the Late Period of Severe Closed Traumatic Brain Injury in Children: Diss. ... Cand. Sci. (Med.)]. Moscow, 2006.
13. Likhterman L.B. Traumatic Brain Injury. Diagnostics and Treatment. Moscow: GEOTAR-Media; 2014. (In Russ.)].
14. 14. Myakotnykh V.S., Talankina N.Z., Borovkova T.A. Clinical, pathophysiological, and morphological aspects of the late period of closed traumatic brain injury. S.S. Korsakov Journal of Neurology and Psychiatry. 2002;102(4):61-65.
15. Ovsyannikov D.M., Chekhonatsky A.A., Kolesov V.N., Bubashvili A.I. Social and epidemiological aspects of traumatic brain injury (review) // Saratov Journal of Medical Scientific Research. 2012. Vol. 8, No. 3. Pp. 777–785.
16. Petrukhin A.S. Childhood Neurology. Moscow, Meditsina, 2004. — 783 p.
17. Talypov A.E., Myatchin M.Yu., Kuksova N.S., Ioffe Yu.S., Kordonskiy A.Yu. Drug-induced neuroprotection in the acute period of moderate traumatic brain injury. Medical Council. 2015;10:82-92.
18. Shalkevich L.V., Lvova O.A., Kulagin A.E., Talabaev M.V., Ivashina E.N., Sulimov A.V. Clinical guidelines for the diagnosis and treatment of traumatic brain injury in children, principles of clinical examination. Pediatric Neurology, issue 3: clinical guidelines / edited by V.I. Guzeva. Moscow: MK, 2015. pp. 147–174.
19. Akhtar JI. Digital decoding of pediatric traumatic brain injury. Crit Care Med. 2015;43(3):722-723. doi:10.1097/CCM.0000000000000799
20. Anderson V, Yeates KO. Pediatric Traumatic Brain Injury. Cambridge University Press; 2010.
21. Dennis EL, Baron D, Bartnik-Olson B, et al. ENIGMA brain injury: Framework, challenges, and opportunities. Hum Brain Mapp. 2022;43(1):149-166. doi:10.1002/hbm.25046

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

22. Griffin, A., Deeba, F., Dennison, T., & Moore, A. (2020). Perspectives on neuropsychology and clinical care in paediatric and adolescent medicine. Clinical Child Psychology and Psychiatry, 25(3), 687-697. https://doi.org/10.1177/1359104520915249
23. Huie JR, Mondello S, Lindsell CJ, et al. Biomarkers for Traumatic Brain Injury: Data Standards and Statistical Considerations. J Neurotrauma. 2021;38(18):2514-2529. doi:10.1089/neu.2019.6762
24. Middleton JA. Practitioner review: Psychological sequelae of head injury in children and adolescents. J Child Psychol Psychiat. 2001;42(2):165-180.
25. Shaw L, Morozova M, Abu-Arafeh I. Chronic post-traumatic headache in children and adolescents: systematic review of prevalence and headache features. Pain Manag. 2018;8(1):57-64.