

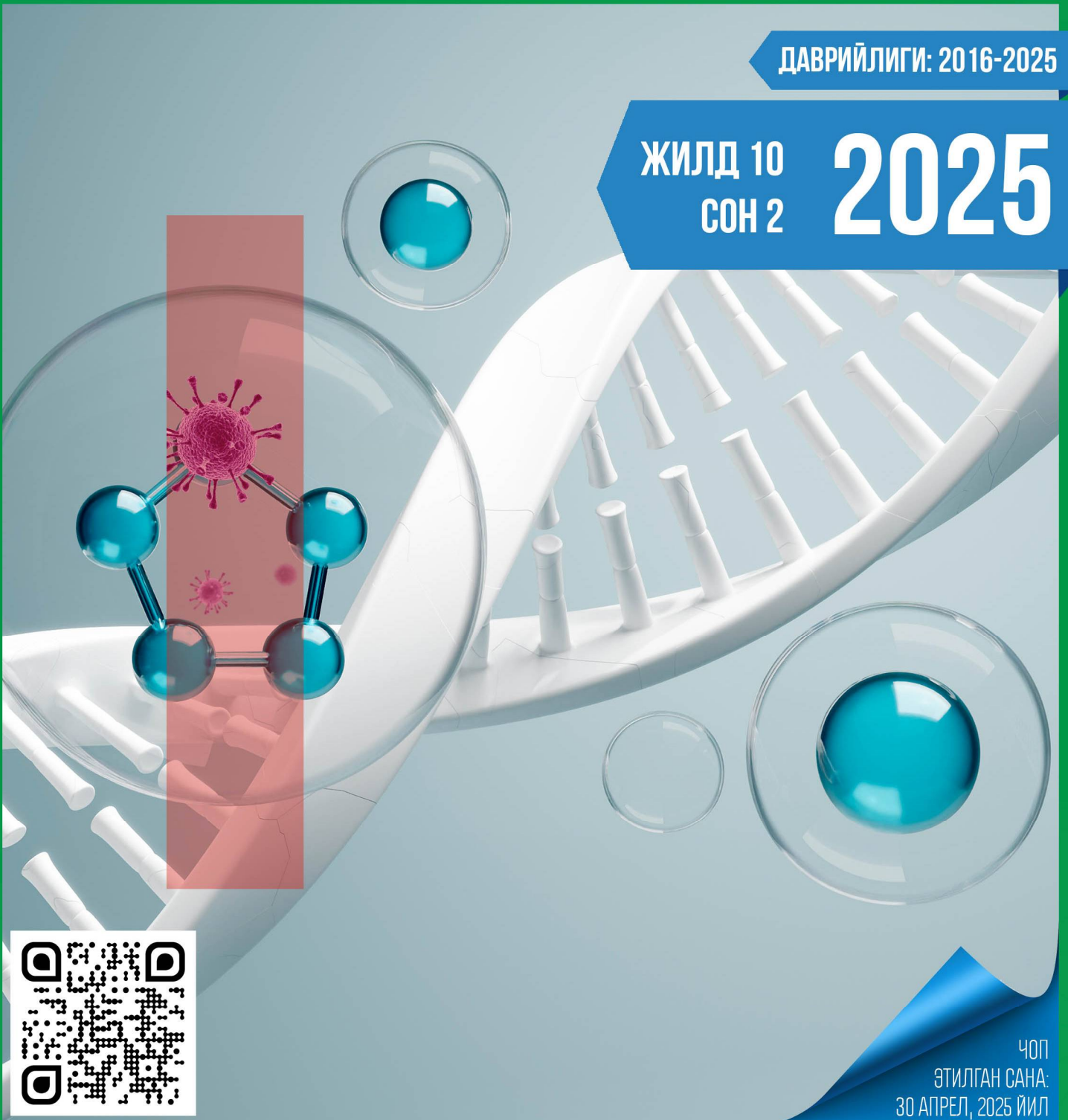
# БИОМЕДИЦИНА ВА АМАЛИЁТ ЖУРНАЛИ

ЖУРНАЛ БИОМЕДИЦИНЫ И ПРАКТИКИ  
JOURNAL OF BIOMEDICINE AND PRACTICE

ДАВРИЙЛИГИ: 2016-2025

ЖИЛД 10  
СОҢ 2

2025



ЧОП  
ЭТИЛГАН САНА:  
30 АПРЕЛ, 2025 ЙИЛ

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10 ЖИЛД, 2 СОН

ЖУРНАЛ БИМЕДИЦИНЫ И ПРАКТИКИ

ТОМ 10, НОМЕР 2

JOURNAL OF BIOMEDICINE AND PRACTICE

VOLUME 10, ISSUE 2



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MODERN APPROACHES IN PRACTICAL SURGERY

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2.	<b>Arziev Ismoil Alievich</b> TECHNIQUE AND FEATURES OF SURGICAL CORRECTION OF DAMAGE TO THE MAIN BILE DUCTS THAT OCCURRED INTRAOPERATIVELY.....	17
3.	<b>Anarboev Sanjar Alisherovich</b> IMPROVEMENT OF SURGICAL TREATMENT OF RECURRENT FORMS OF LIVER ECHINOCOCCOSIS.....	26
4.	<b>Askarova Nafisa Rinatovna</b> VULVARICOSITY: FEATURES OF DIAGNOSIS AND TREATMENT IN PATIENTS WITH VARICOSE VEINS AND PREGNANT WOMEN.....	33
5.	<b>Akhmedov Rakhmatillo Furkatovich</b> SURGICAL TACTICS FOR IATROGENIC INJURIES TO THE BILE DUCTS.....	38
6.	<b>Achilov Mirzakarim Temirovich</b> SURGICAL TREATMENT OF PANCREATIC HEAD TUMORS.....	44
7.	<b>Allazov Iskandar Salakh ogli</b> CYSTIC KIDNEY NEOPLASMS: RETROSPECTIVE ASPECTS AND MODERN VIEWS.....	49
8.	<b>Allazov Salakh Allazovich</b> LAPAROSCOPIC AND RETROPERITONEOSCOPIC OPERATIONS IN UROLOGY...	57
9.	<b>Bobokulov Nurullo Asadovich, Ablyatifov Aziz Baxriyarovich</b> OPTIMIZATION OF SURGICAL TREATMENT IN UROLOGY: THE ROLE OF SIMULTANEOUS LAPAROSCOPIC OPERATIONS.....	66
10.	<b>Bakhriddinov Bekzod Rustamovich, Aliev Mansur Abduholikovich</b> MR SPECTROSCOPY OF BRAIN TUMORS AND CORRELATION OF METABOLIC CHANGES WITH HISTOLOGICAL CHARACTERISTICS.....	72
11.	<b>Davronov Alisher Uktamovich, Kurbaniyazov Bobojon Zafarjonovich</b> LAPAROSCOPIC REPAIR OF PERFORATED ULCERS: ADVANTAGES AND CLINICAL OUTCOMES.....	79
12.	<b>Daminov Feruz Asatullaevich, Bobokulov Azamat Uktamovich</b> FACTORS IN THE DEVELOPMENT OF BLEEDING IN GASTRODUODENAL ULCERS. (LITERATURE REVIEW).....	88
13.	<b>Davronov Oybek Otabek ugli</b> MODERN VIEWS ON THE PATHOMORPHOLOGICAL ASPECTS OF CHANGES IN THE FORNICAL APPARATUS AND ADJACENT STRUCTURES DURING URINARY STONE DISEASE.....	95
14.	<b>Egamberdiev Abdukakhkhor Abdukodirovich</b> FEATURES OF SURGICAL TREATMENT OF HERNIA OF THE ESOPHAGEAL HOLE OF THE DIAPHRAGM.....	101
15.	<b>Esirgapov Sardor Nursalimovich, Abduraxmanov Diyor Shukrullaevich</b> RESULTS OF HERNIOPLASTY OF VENTRAL HERNIAS WITH ABDOMINOPTOSIS.....	106
16.	<b>Gafarov Rushen Refatovich</b> CLASSIFICATION OF POSTOPERATIVE COMPLICATIONS OF HOLMIUM LASER ENUCLEATION OF THE PROSTATE: ROLE OF A UNIFIED APPROACH.....	112
17.	<b>Giyasova Nigora Kobilovna</b> MODERN APPROACHES TO DETECTING ARTHROSIS AT EARLY STAGES AND POSSIBILITIES OF PATHOGENETIC TREATMENT OF THIS DISEASE.....	118

18.	<b>Ishmuradov Bakhron Tursunovich</b> EFFICACY OF ENDOSCOPIC BALLOON DILATION IN TREATMENT OF ACQUIRED URETERAL STRICTURES.....	127
19.	<b>Islomov Nuriddin Komil ugli, Mustafakulov Ishnazar Boynazarovich, Julbekov Komil Islomovich</b> MANAGEMENT FOR SIGMOID VOLVULUS.....	131
20.	<b>Ismati Amir Olimovich, Mamarajabov Sobirjon Ergashevich, Anosov Viktor Davidovich</b> A NOVEL PROGNOSTIC SYSTEM FOR 30-DAY MORTALITY IN PATIENTS WITH ULCER UPPER GASTROINTESTINAL BLEEDING.....	141
21.	<b>Jalilov Khusan Mukhidinovich, Mansurov Jaloliddin Shamsiddinovich</b> PREOPERATIVE INCIDENCE OF DEEP VEIN THROMBOSIS AFTER HIP FRACTURES IN KOREANS.....	151
22.	<b>Kadirov Rustam Nadirovich, Khursanov Yokubjon Erkin ugli, Kamolov Sardor Jamolovich</b> MODERN ASPECTS OF DIAGNOSING AND TREATMENT OF ACUTE PATHOLOGY OF THE ABDOMINAL CAVITY ORGANS.....	157
23.	<b>Karabayev Djamshidkhan Shavkatovich, Shakhanov Shavkat Safarovich, Nekbayev Hasan Sayfulloyevich</b> DETERMINATION OF THE EFFECTIVENESS AND PREVENTION OF ARTHRITIS IN PATIENTS USING LOW-VIBRATION LASER BEAMS.....	162
24.	<b>Kurbaniyazov Zafar Babajanovich, Mukhiddinov Bobur Khuroz Ugli, Askarov Pulat Azadovich</b> EVALUATION OF THE EFFECTIVENESS OF ARTIFICIAL INTELLIGENCE IN LAPAROSCOPIC CHOLECYSTECTOMY.....	168
25.	<b>Khaidarov Numon Bozor ugli, Rakhmanov Kosim Erdanovich</b> IMPROVEMENT OF SURGICAL TREATMENT OF PATIENTS WITH DESTRUCTIVE PANCREATITIS.....	175
26.	<b>Khalimova Zamira Yusufovna, Narimova Gulchehra Jumaniyazovna, Kurbanova Sitara Shukhratovna, Ablakulova Munisa Xamrakulovna</b> INTERACTION BETWEEN MELATONIN AND METABOLIC PARAMETERS IN OBESE WOMEN: A CLINICAL ANALYSIS.....	181
27.	<b>Khurazov Ganisher Mususrmonovich</b> MODERN APPROACHES TO TREATING PROSTACH ADENOMA: EFFICIENCY, SAFETY, AND IMPACT ON PATIENTS' LIFE QUALITY.....	190
28.	<b>Khursanov Yokubjon Erkin ugli, Sattorov Abbos Xalilovich</b> EFFICIENCY OF USING MINIMALLY INVASIVE METHODS IN THE SURGICAL TREATMENT OF COMPLICATED ACUTE CHOLECYSTITIS.....	196
29.	<b>Khamrakulov Shokhrukh Farukhovich, Mamarajabov Sobirzhon Irgashevich, Rasulov Khamidulla Abdullaevich</b> LAPAROSCOPIC TREATMENT OF STRICTURED HERNIAS OF THE ANTERIOR ABDOMINAL WALL.....	201
30.	<b>Khodjimatom Gulomidin Minkhodzhievich, Yigitov Ayubkhon Azizbekovich, Yahyoev Sardorbek Mamasobir ugli</b> IMPROVING THE OUTCOMES OF TREATMENT OF COMBINED SURGICAL DISEASES OF ABDOMINAL ORGANS USING SIMULTANEOUS LAPAROSCOPIC SURGERIES.....	207
31.	<b>Khaidarov Numon Bozor ugli, Rakhmanov Kosim Erdanovich</b> IMPROVEMENT OF SURGICAL TREATMENT OF PATIENTS WITH DESTRUCTIVE PANCREATITIS.....	217

32.	<b>Khamdamov Olim Dilmurodovich, Rakhmanov Kosim Erdanovich</b> OPTIMIZATION OF TACTICAL AND TECHNICAL ASPECTS OF SURGICAL TREATMENT OF PULMONARY ECHINOCOCCOSIS.....	223
33.	<b>Khashimov Rustam Uktamjanovich, Rizaev Jasur Alimjanovich, Rakhmanov Kosim Erdanovich</b> IMPROVEMENT OF SURGICAL TREATMENT OF PATIENTS WITH INGUINAL HERNIAS.....	229
34.	<b>Mamanov Muhammad Chorievich</b> IMPROVEMENT OF SURGICAL TACTICS IN COMPLICATED AND COMPLEX FORMS OF LIVER ECHINOCOCCOSIS.....	235
35.	<b>Mamatov Karim Saidullaevich, Rakhmanov Kosim Erdanovich</b> EFFECTIVENESS OF MINIMALLY INVASIVE METHODS IN SURGICAL TREATMENT OF CHOLANGITIS.....	243
36.	<b>Mardonov Bobosher Amirovich.</b> SURGICAL TACTICS FOR POSTCHOLECYSTECTOMY SYNDROME: FEATURES AND CHALLENGES OF IMPLEMENTATION.....	249
37.	<b>Mukhiddinov Temur Djakhangirovich, Askarov Pulat Azadovich</b> IMPROVEMENT OF SURGICAL TREATMENT OF VENTRAL HERNIAS WITH CONCOMITANT PATHOLOGY OF ABDOMINAL ORGANS.....	256
38.	<b>Mansurov Jalolidin Shamsidinovich</b> COMPARISON OF ULTRASOUND-GUIDED HYDROSTATIC REDUCTION OF INTUSSUSCEPTION RESULTS BETWEEN PEDIATRIC AND NON-PEDIATRIC RADIOLOGISTS AND RESIDENTS.....	262
39.	<b>Musoyev Sodikjon Toirovich</b> MODERN ALGORITHMS FOR THE TREATMENT OF ACUTE AND CHRONIC CHOLECYSTITIS: FROM CONSERVATIVE THERAPY TO SURGERY.....	273
40.	<b>Negmatov Ismatillo Savridinovich</b> CT DIAGNOSTICS, CLASSIFICATIONS, AND DEVELOPMENT OF A REPORTING TEMPLATE FOR ACUTE DIVERTICULITIS OF THE COLON.....	279
41.	<b>Normamatov Bakhriddin Pirmamatovich, Rakhmanov Kosim Erdanovich</b> OPTIMIZATION OF COMPREHENSIVE SURGICAL TREATMENT OF ACUTE PURULENT CHOLANGITIS USING HYBRID MINIMALLY INVASIVE TECHNOLOGIES.....	293
42.	<b>Nurillayev Khasan Zhamshidovich</b> ACUTE CHOLECYSTITIS IN THE ELDERLY: FEATURES OF THE CLINICAL COURSE, DIAGNOSIS AND TREATMENT.....	300
43.	<b>Obidov Shokhrukh Khabibovich, Mamarajabov Sobirjon Ergashevich</b> MODERN APPROACHES TO SURGICAL TREATMENT OF INGUINAL HERNIAS IN OBESE PATIENTS.....	306
44.	<b>Rabbimova Maftuna Ulugbekovna.</b> ENDOSCOPIC ULTRASOUND ELASTOGRAPHY: CURRENT STATE AND DEVELOPMENTAL DIRECTIONS.....	313
45.	<b>Rakhmatov Istodjon Samedjonovich</b> THE ROLE AND IMPORTANCE OF X-RAY EXAMINATIONS IN MEDICINE.....	337
46.	<b>Ruziboyev Sanjar Abdusalomovich, Allaberdiyev Nemat Abdushukurovich, Shavazi Ramiz Nuralievich</b> REMOTE RESULTS OF THE IMPROVED LIXTENSHTEIN MODIFICATION.....	343
47.	<b>Ruziboev Sanjar Abdusalomovich, Mardonov Vohid Narzullayevich, Shavazi Ramiz Nuralievich</b> EXPERIMENT OF APPLYING ANTI-ADHESIVE PREPARATIONS IN THE EXPERIMENT.....	352

48.	<b>Rizayev Jasur Alimjanovich, Abdullayev Sayfulla Abdullayevich</b> THE SIGNIFICANCE OF NUTRITIONAL SUPPORT IN THE SURGICAL TREATMENT OF PURULENT-NECROTIC INFLAMMATION OF SOFT TISSUES.....	360
49.	<b>Rizayev Ezoz Alimdjanovich, Kurbaniyazov Zafarjon Babajanovich</b> PREDICTION OF ACUTE PANCREATITIS OUTCOMES BASED ON LAPAROSCOPY DATA AND THE BALTHAZAR SCALE.....	365
50.	<b>Ravshanov Mukhammadali Ikhtiyorovich, Askarov Pulat Azadovich</b> MINIMALLY INVASIVE METHODS OF SURGICAL TREATMENT OF OBSTRUCTIVE JAUNDICE OF BENIGN ORIGIN.....	373
51.	<b>Rashidova Xurshida Abduvoxidovna</b> POSSIBILITIES OF CLINICAL AND LABORATORY AND INSTRUMENTAL STUDIES IN NON – ALCOHOLIC FATTY LIVER DISEASE.....	379
52.	<b>Salimov Eshdavlat Eshmakhmatovich, Rakhmanov Kosim Erdanovich</b> IMPROVEMENT OF SURGICAL TREATMENT OF PATIENTS WITH THYROID NODULES.....	386
53.	<b>Sayinaev Farrukh Karamatovich, Rakhmanov Kosim Erdanovich</b> ASPECTS OF LAPAROSCOPIC HERNIOPLASTY FOR VENTRAL HERNIAS.....	392
54.	<b>Salokhiddinov Jurabek Saidakhmatovich</b> TOPICAL ISSUES OF SURGICAL TREATMENT OF TOXIC FORMS OF GOITER...397	397
55.	<b>Suvonov Shokhrux Shukhrat ugli</b> CURRENT METHODS OF TREATMENT OF LARGE AND GIANT VENTRAL HERNIAS USING TENSION-FREE HERNIOPLASTY.....	403
56.	<b>Shirov Bobur Furkatovich, Mardieva Gulshod Mamatmuradova</b> EVALUATION OF THE DIAGNOSTIC EFFECTIVENESS OF THE BONE COVERAGE COEFFICIENT AND SIDE RATIO COEFFICIENT COMPARED TO THE GRAF METHOD.....	409
57.	<b>Shomurodov Khabibullo Abdumalik ugli, Daminov Feruz Asadullaevich, Rakhmanov Kosim Erdanovich</b> APPLICATION OF LAPAROSCOPY IN SURGICAL TREATMENT OF ACUTE DESTRUCTIVE CHOLECYSTITIS.....	419
58.	<b>Turakulov Vali Norkulovich.</b> MEASURES TO IMPROVE THE QUALITY OF LIFE OF PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD).....	424
59.	<b>Tagaev Abror Ilkhomovich, Rakhmanov Kosim Erdanovich</b> OPTIMIZATION OF SURGICAL TREATMENT OF PATIENTS WITH PURULENT PLEURISIS.....	430
60.	<b>Toirov Abdukhomit Suvonovich, Musoev Sodiqjon Toirovich</b> THE ROLE OF ENDOVENOUS LASER COAGULATION IN THE COMPLEX TREATMENT OF VARICOSE VEINS OF THE LOWER EXTREMITIES.....	437
61.	<b>Turdumatov Jamshed Anvarovich, Sobirova Nilufar</b> RADIOLOGICAL SEMIOTICS OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE IN TYPE II DIABETES MELLITUS.....	442
62.	<b>Tukhtayev Firdavs Mukhidinovich, Ergashev Arslonbek Shukhratjon ugli</b> LAPAROSCOPIC TREATMENT OF CYSTIC KIDNEY NEOPLASMS: EFFICACY AND RESULTS.....	451
63.	<b>Umedov Xushvaqt Alisherovich,</b> THE ROLE AND IMPORTANCE OF VIDEOLAPAROSCOPY IN CLOSED ABDOMINAL INJURIES.....	457
64.	<b>Umedov Xushvaqt Alisherovich</b> IMPROVEMENTS IN DIAGNOSTIC AND THERAPEUTIC CAPABILITIES OF VIDEOLAPAROSCOPY WITH CLOSED ABDOMINAL LESIONS.....	463

65. **Usarov Sherali Nasretidinovich**  
ANALYSIS OF THE RESULTS OF SURGICAL TREATMENT OF PATIENTS WITH INGUINAL HERNIAS.....474
66. **Yanova Elvira Umarjonovna, Urokov Farrukh Ibodullaevich**  
TYPES OF ANGIODYSPLASIA IN KIMMERLE ANOMALY BY MAGNETIC RESONANCE ANGIOGRAPHY.....479
67. **Yuldashev Parda Arzikulovich, Rakhmanov Kosim Erdanovich, Davlatov Salim Sulaymonovich**  
OPTIMIZATION OF SURGICAL APPROACHES IN THE TREATMENT OF POSTOPERATIVE VENTRAL HERNIAS.....491
68. **Alisher Zayniyev Faridunovich**  
A NEW PLASMAPHERESIS METHOD FOR PREOPERATIVE PREPARATION IN PATIENTS WITH THYROTOXICOSIS.....499
69. **Ablyazov Otabek Vakhobovich, Yakubov Golib Akbarovich, Ablyazov Abduvakhob Abdumadzhidovich, Madumarova Zarnigor Shukhratovna, Turgunov Shomakhmud Shorakhimovich**  
IMAGING METHODS FOR CERVICAL SPINAL CANAL STENOSIS.....508
70. **Kurbaniyazov Bakhodir Zafarzhonovich, Ashurov Akmal Khusanovich**  
TACTICAL AND TECHNICAL ASPECTS OF TRANSABDOMINAL LAPAROSCOPIC HERNIALLOPLASTY FOR INGUINAL HERNIAS.....512
71. **Kilichev Rashid Nematovich, Mamarajabov Sobirjon Ergashevich, Babakalanov Shuhrat Ibragimovich, Oltiyev Elyor Doniyorovich.**  
EVALUATION OF THE EFFECTIVENESS OF HAL-RAR AND LHP SURGICAL APPROACHES IN THE TREATMENT OF HEMORRHOIDS.....520
72. **Ahmedov Gayrat Keldibayevich, Gulamov Olimjon Mirzakhitovich, Azizov Temur Alisher ugli, Toshkenboyev Firdavs Ramatillo Zoda, Khudaynazarov Utkir Rabbimovich.**  
ANASTOMOSIS IN ESOPHAGULAR CANCER OPERATIONS.....526
73. **Teshayev Shuxrat Jumayevich, Jarilkasinova Gauzar Januzakovna.**  
SOCIAL AND CLINICAL-BIOCHEMICAL FACTORS IN THE PATHOGENESIS OF GASTRITIS AND ULCER DISEASE: STUDYING SMOKING AND PROFESSIONAL DEPENDENCE.....531
74. **Khaibullina Zarina Ruslanovna, Babajanov Azam Khasanovich, Djuraeva Nigora Mukhsumovna, Abdukhalimova Khanum Valentinovna**  
VON WILLEBRAND FACTOR DYNAMICS AFTER RELATED LIVER TRANSPLANTATION.....538
75. **Khaydarova Nargiza Akhtamzhon kizi**  
ANALYSIS OF MORPHOFUNCTIONAL AND MORPHOMETRIC FEATURES OF THE THYROID GLAND IN 5-MONTH-OLD MONGREL RATS IN THE OBSERVATION GROUP.....549
76. **Mardiyeva Gulshod Mamatmuradovna, Abdullaeva Mukhiba Nigmatovna, Matyakupov Azim Rustemovich, Nurmatatova Ozoda Abdurasul kizi.**  
ROENTGEN-PROTEINOLOGICAL RELATIONSHIPS IN THE DYNAMICS OF PNEUMONIA IN NEWBORNS, TAKING INTO ACCOUNT THE DEGREE OF THEIR MATURITY.....556
77. **Karabyev Djamshidkhan Shavkatovich, Shakhanov Shavkat Safarovich, Shakirov Bobur**  
PREVENTION AND EFFECTIVENESS OF ARTHRITIS IN PATIENTS WITH BURNS USING LOW VIBRATION LASER BEAMS.....564
78. **Исмаилов Зоҳиджан, Мирджуроев Элбек**  
ЗАБОЛЕВАНИЯ ПЕРИФЕРИЧЕСКОЙ НЕРВНОЙ СИСТЕМЫ, ИХ ДИАГНОСТИКА, ВЫБОР ПРАВИЛЬНОЙ ТАКТИКИ ЛЕЧЕНИЯ И ШИРОКОЕ ВНЕДРЕНИЕ РЕАБИЛИТАЦИОННОЙ РАБОТЫ ПОСЛЕ ПЕРЕНЕСЕННЫХ ЗАБОЛЕВАНИЙ...570
79. **Ismailov Zakhidjon, Mirdjuraev Elbek**  
EXAMINATION OF CHILDREN WITH NEUROPATHY, TIMELY DIAGNOSIS, TREATMENT AND REHABILITATION MEASURES AFTER ILLNESSES.....578

# БИОМЕДИЦИНА ВА АМАЛИЁТ ЖУРНАЛИ

ЖУРНАЛ БИОМЕДИЦИНЫ И ПРАКТИКИ | JOURNAL OF BIOMEDICINE AND PRACTICE

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## EXAMINATION OF CHILDREN WITH NEUROPATHY, TIMELY DIAGNOSIS, TREATMENT AND REHABILITATION MEASURES AFTER ILLNESSES

**For citation:** ISMAILOV Zoxidjan, MIRDJURAYEV Elbek. EXAMINATION OF CHILDREN WITH NEUROPATHY, TIMELY DIAGNOSIS, TREATMENT AND REHABILITATION MEASURES AFTER ILLNESSES // Journal of Biomedicine and Practice. 2025, vol. 10, issue 2.

 <http://dx.doi.org/10.5281/zenodo.15199856>

### ABSTRACT

**Objective:** Treatment of children with neuropathy by maximizing their quality of life using effective treatment methods. Timely implementation of rehabilitation processes after treatment.

**Methods.** This study used observational, prospective and cohort methods. Based on the goals and objectives of the study, the main and control groups were formed. The comparison groups were comparable by gender and age. The scope of the study included: collection of anamnesis, somatic and neurological examination, balance assessment (Standing Balance R, Bohannon Scale), assessment of quality of life impairment according to the Rankin scale, assessment of physical capabilities according to the Rand scale, assessment of pain due to the disease, pain assessment according to the visual analog scale (VAS), assessment of the severity of the asthenic state (according to L.R. Krupp), assessment of perceived barriers and motivators of maintaining physical activity.

**Results:** As with some patients in the comparison group, small changes in the length of the right and left legs were observed after rehabilitation, and some patients developed scoliosis on the right or left side of the body depending on the length of the legs. Patients with scoliosis are treated with lechebnye meropriyatya. Complex therapeutic physical culture (ThPC) is aimed at strengthening the spine and preventing scoliosis. The training includes space, basic training and groundwork. Complex physical training helps to restore the balance of the muscles and ligaments, remove the izbitochnoy gruzki and the spine, improve and strengthen the muscles and spine, and has a toning effect on the whole organism.

**Conclusion:** It is necessary to start medical rehabilitation for neuropathies as early as possible, to fully monitor sick children through a continuous, comprehensive, unified systemic program of medical rehabilitation, to prevent exacerbations of complications of diseases by

conducting a planned process of medical rehabilitation individually, continuously, in stages within the established timeframes.

**Key words:** children, peripheral nervous system, skeleton, movement, treatment, rehabilitation, central nervous system.

### 1. Introduction

As the child grew older, the number of complaints about pain in the joints of the legs, as well as hypoesthesia in the legs, increased. The table below presents the results of our clinical and neurological examination (Table 1).

**Table 1**

**Results of clinical and neurological examination of children.**

<i>Clinical indicators</i>	<i>Results</i>	<b>Neuropathy of the feet, %</b>	<b>p</b>
<i>Swelling of the right leg</i>	There is	100	<0,01
	There is not	0	
<i>Swelling of the left leg</i>	There is	97,7	<0,07
	There is not	2.3	
<i>Right-sided discriminatory sensation</i>	There is	72,1	
	There is not	27,9	<0,05
<i>Left-sided discriminatory sensation</i>	There is not	53,5	
	There is	46,5	<0,001
<i>Pain in the right leg</i>	There is not	97,7	
	There is	2,3	<0,001
<i>Pain in the left leg</i>	There is not	100	

Correlation analysis (Spearman's rank correlation coefficient) for leg neuropathy showed that the main neurological complaints (dysesthesia, paresthesia in the legs, numbness, pain along the nerve), age, cerebrovascular accident, dysesthesia (numbness) were associated with leg joint pain (correlation coefficient 0.526), but were weakly correlated with hip pain (correlation coefficient 0.269) and age (correlation coefficient 0.082). It was found that leg pain was moderately correlated with heel pain (0.360) and weakly correlated with age (correlation coefficient 0.124). It was analyzed the presence of correlations between the main clinical signs of peripheral nervous system pathology (dysesthesia, pain in the joints of the legs and the age of the child). Clinical manifestations of peripheral neuropathy in the observed patients depended on the stage of the disease.

In the acute phase of the disease, 71.2% of patients experienced spontaneous pain in the compression zone. The irradiation of pain along the damaged nerves is less than local pain in the area of compression – 40%. In 68.8% of our patients, pain was noted in the damaged nerve fiber upon palpation. The pain syndrome was characterized by burning, pressing, sometimes sharp pulling pain. The intensity of pain is greatest during neurosurgical interventions on nerve trunks. Pain syndrome in the residual period was less pronounced than in the acute period, but was more constant and, as a rule, was of a centralized nature. This was observed in 67.5% of cases in clinical trials. In this case, irradiating pain is often encountered - in 41.8% of cases. Pain in the affected nerve fiber during palpation was observed in 47.9% of cases. The pain syndrome was burning, stabbing and aching. Almost all patients with peripheral neuropathy experience sensory disturbances. Subjective sensory disturbances manifested as paresthesias. It was found that 72.9% of patients periodically experience tingling, tingling sensations reminiscent of “ant walking”, and numbness occurring in the innervation

zone of the damaged nerve. Seven percent of patients had difficulties performing fine, targeted movements — "afferent paresis." Along with subjective manifestations of sensory disturbances, objective disturbances of peripheral pain sensitivity were detected in the form of hyperesthesia, less frequently irritation and hypoesthesia. Thus, in the acute phase of the disease, 64.2% of patients had hypoesthesia of pain sensitivity, and 27.3% had hyperesthesia. In the residual phase, 31.9% of patients had descending sensitivity disorders, and 7.2% had irritation-type sensitivity disorders. At the same time, no differences in sensory disturbances and the main pathogenetic form were revealed. In axonotmesis, pronounced disturbances were detected in 57.6% of patients with the descent type (with neuropraxia - only in 10.1%), and with the irritation type - in 39.9% of patients (with neuropraxia - in 14.9%). In the acute phase of the process, 72.3% of patients showed the effect of movement disorders in the form of paresis of the muscles innervating the affected nerves. The most dramatic, threefold decrease in muscle strength was observed in 30% of patients. Less common muscle paresis up to 4 points was observed in 21.2% of patients. Some patients had motor disorders: 0-1 point – 12.7% and 2 points – 15.8%. The frequency of movement disorders in the chronic period of the disease is higher than in the acute period - 80.9%. However, the degree of paresis of the affected muscles was somewhat lower. Pronounced movement disorders (immobility) were detected in 10.3% of patients. Paresis in patients was assessed as 4 points in 41.7%, 3 points in 14.9% and 2 points in 13.9%. Motor disorders were more common in cases of partial axonal rupture - axonotmesis was associated with lack of movement in 44.9% of patients, and neuropraxia - in 10.1% of patients. It amounted to 18.9 percent. Of the trophic disorders, hypotrophy of normal tissues was observed in 28.6% of cases. In the acute phase of the process, vegetative vasomotor disorders are characteristic: cyanosis, edema of the distal parts of the legs, a decrease in temperature in the innervation zone of the affected nerve. In the residual period, dystrophic processes localized in the innervation zone of the affected nerves caused the occurrence of dystrophic diseases such as impaired skin trophism, brittle nails, hair loss, and osteoporosis. The degree of reflex impairment was largely related to nerve fiber damage. Absence of reflexes was observed in 34.2% of patients with axonotmesis and in 15.2% of patients with neuropraxia. Hyperreflexia was detected in some patients (5.4%).

## **Patients and Methods**

### **1. 1. Patients**

The study involved 100 children with peripheral nervous system diseases aged 3 to 17 years. They were divided into control, main and comparative groups depending on the type, duration and severity of the disease. When distributing into groups, the children's gender, diagnosis of diseases and practical methods of rehabilitation were taken into account.

### **1. 2. Treatment methods**

Patients in the main group received planned complex restorative treatment for an average of 45–50 days.

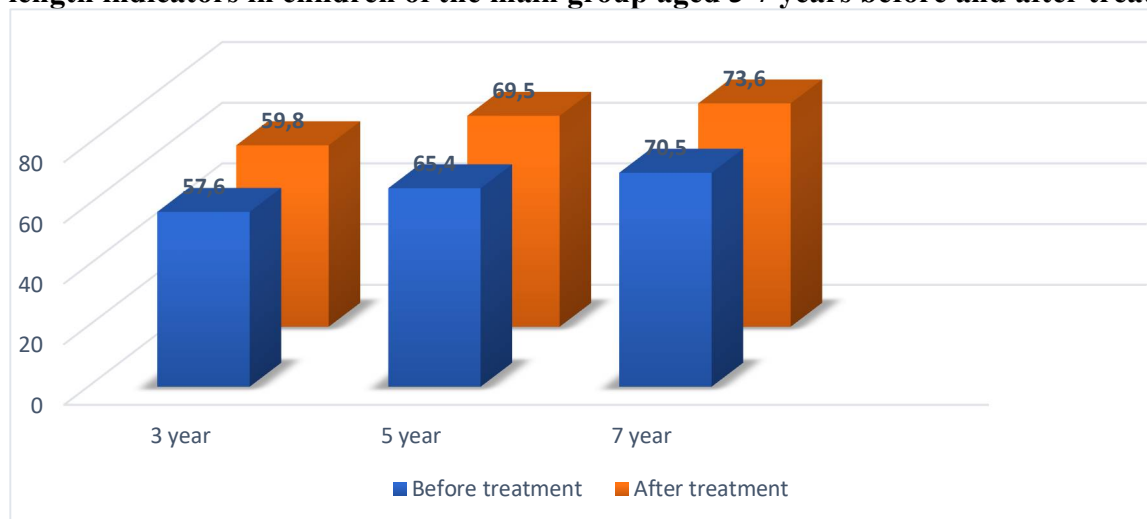
In the main group, almost all children (97%) showed improvement after the rehabilitation treatment. Thus, in the main group of 8-year-old children, the height increased by  $2.6 \pm 0.3$  cm, reaching  $82.5 \pm 0.5$  cm in 92% of the examined children of this age group, while 8% showed minor changes at the level of  $80.7 \pm 0.3$  cm. In the comparison group, 76% of 8-year-old children showed a slight change of  $79.3 \pm 0.7$  cm, while 34% of children showed no change. In the main group, 91% of children under 10 years of age showed significant improvements, with the average increase in leg length being  $2.3 \pm 0.4$  cm, and the overall increase being  $91.6 \pm 0.4$  cm, while 9% of the examined children showed minor changes and the leg length was  $88.3 \pm 0.5$  cm. In the comparison group, only 10% of 10-year-old children showed minor changes and the leg length was  $87.8 \pm 1.0$  cm, and 38% of children showed no positive changes at all. In the main group, in 11-year-old children who received rehabilitation treatment, the length of the legs increased by an average of  $2.8 \pm 0.3$  cm and amounted to  $93.0 \pm 0.4$  cm (95%). At the same time, 5% of children in the main group showed a slight improvement in their condition, and the indicator reached  $90.6 \pm 0.4$  cm. Only 69% of children in the comparison group showed improvement. Thus, after rehabilitation, the leg length of 11-year-old children reached  $90.4 \pm 0.5$  cm ( $p < 0.05$ ). No positive changes were found in 31% of children in the comparison group.

## 2. Results

It has been shown that in children aged 3 to 7 years, the length of the foot depends on the age and sex of the child. As is known, the length of the leg is measured from the anterior iliac crest to the medial malleolus. Thus, before rehabilitation, 56% of three-year-old children ( $p < 0.05$ ) had a foot length of  $57.6 \pm 1.5$  cm (hypotrophy), and 44% of children had a foot length of  $51.8 \pm 1.6$  cm (atrophy), while in children under 5 years of age, 63% of children before rehabilitation had a foot length of  $65.4 \pm 1.7$  cm ( $p < 0.05$ ) (hypotrophy) and 37% of children were found with a height of  $61.3 \pm 1.4$  cm (atrophy). Before rehabilitation, 58% of 7-year-old children had a leg length of  $70.5 \pm 1.6$  cm (hypotrophy), and 42% of children had a leg length of  $68.4 \pm 1.4$  cm (atrophy). In the main group, almost all children (96%) showed an improvement in their condition after a set of rehabilitation measures. Thus, in 3-year-old children, the leg length increased by an average of  $2.4 \pm 0.2$  cm, and in 90% of children of this age, the leg length was  $59.8 \pm 1.2$  cm, while in 10% of children, the leg length decreased and the leg length was  $58.6 \pm 1.1$  cm ( $p < 0.05$ ). In the comparison group, where traditional rehabilitation methods were used, improvement occurred in only 71% of children. Thus, in the comparison group, leg length increased slightly and amounted to  $58.2 \pm 0.8$  cm in 3-year-old children, while in the main group, leg length increased by an average of  $3.7 \pm 0.1$  cm and amounted to  $69.5 \pm 0.5$  cm in the children studied (92%) ( $p < 0.05$ ). In 8% of children, the leg length increased slightly and amounted to  $67.8 \pm 1.3$  cm. Among children under 5 years of age, an improvement in the indicators was noted in 68% of children in the control group. The leg length partially increased and amounted to  $66.5 \pm 1.5$  cm, while in 32% of legs the length remained unchanged, which indicates the presence of hypotrophy or atrophy of the legs. In the main group, the leg length of 7 year old children increased by an average of  $2.8 \pm 0.2$  cm and was  $73.6 \pm 0.3$  cm in the study group (90%) ( $p < 0.05$ ). Insignificant changes occurred in the comparison group. Thus, among the examined 7 year old children, 64% of them had an increase in leg length by  $71.6 \pm 0.4$  cm ( $p < 0.05$ ). In 36% of children in the comparison group, no positive changes were detected (Figure 1).

Figure 1

Leg length indicators in children of the main group aged 3-7 years before and after treatment



### 2.1. Improvement of treatment group after 45 day complex rehabilitation.

Before rehabilitation, it was found that in 62% of 8 yearold children the average leg length was  $78.5 \pm 1.7$  cm (hypotrophy) ( $p < 0.05$ ), and in 38% of children the leg length was  $76.4 \pm 1.5$  cm (atrophy). In 70% of 10 year old children, the average leg length was  $87.3 \pm 1.7$  cm (hypotrophy) ( $p < 0.05$ ), and in 30% of children, the leg length was  $85.7 \pm 1.3$  cm (atrophy). Before rehabilitation, in 11-year-old children, the average leg length was  $90.6 \pm 1.4$  cm (hypotrophy) in 67% of children, and in 37% of children, the average leg length was  $88.8 \pm 1.2$  cm ( $p < 0.05$ ).

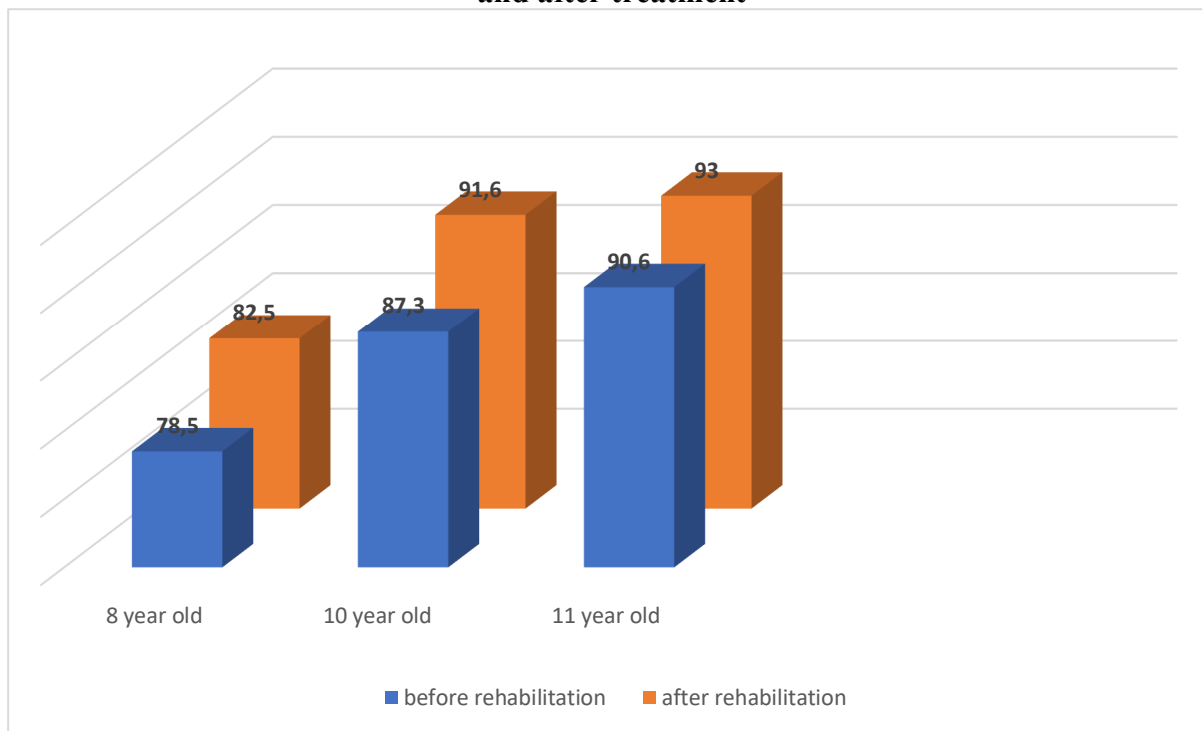
In the main group, almost all children (97%) showed improvement after the rehabilitation treatment. Thus, in the main group of 8-year-old children, the height increased by  $2.6 \pm 0.3$  cm,

reaching  $82.5 \pm 0.5$  cm in 92% of the examined children of this age group, while 8% showed minor changes at the level of  $80.7 \pm 0.3$  cm. In the comparison group

76% of 8-year-old children showed minor changes of  $79.3 \pm 0.7$  cm, while 34% of children showed no changes. In the main group, 91% of children under 10 years of age showed significant improvements, with an average increase in leg length of  $2.3 \pm 0.4$  cm and a total of  $91.6 \pm 0.4$  cm, while 9% of the examined children showed minor changes, with a leg length of  $88.3 \pm 0.5$  cm. In the comparison group, only 10% of 10-year-old children showed minor changes, with a leg length of  $87.8 \pm 1.0$  cm, and 38% of children showed no positive changes at all. In the main group, the leg length of 11-year-old children who received rehabilitation treatment increased by an average of  $2.8 \pm 0.3$  cm and amounted to  $93.0 \pm 0.4$  cm (95%). At the same time, 5% of children in the main group showed a slight improvement and the indicator reached  $90.6 \pm 0.4$  cm. Only 69% of children in the comparison group showed an improvement. Thus, after rehabilitation, the leg length of 11-year-old children reached  $90.4 \pm 0.5$  cm ( $p < 0.05$ ). No positive changes were found in 31% of children in the comparison group (figure 2).

Figure 2

Anthropometric indicators of leg length in children aged 8-11 years of the main group before and after treatment



### 3. Discussion

In 12-year-old children, the average leg length before rehabilitation was  $92.6 \pm 1.3$  cm (hypotrophy) in 88% of children, and  $90.8 \pm 0.3$  cm (atrophy) in 12% of children. Among children aged 13 to 15 years, 92% of children whose leg length was checked before rehabilitation had an average length of  $97.4 \pm 0.5$  cm (hypotrophy), and 8% of children had a leg length of  $95.8 \pm 0.2$  cm (atrophy).

Among children aged 16–18 years, 83% of children whose leg length was checked before rehabilitation had an average leg length of  $110.6 \pm 0.8$  cm (hypotrophy), and 17% of children had an average leg length of  $108.3 \pm 0.6$  cm (atrophy).

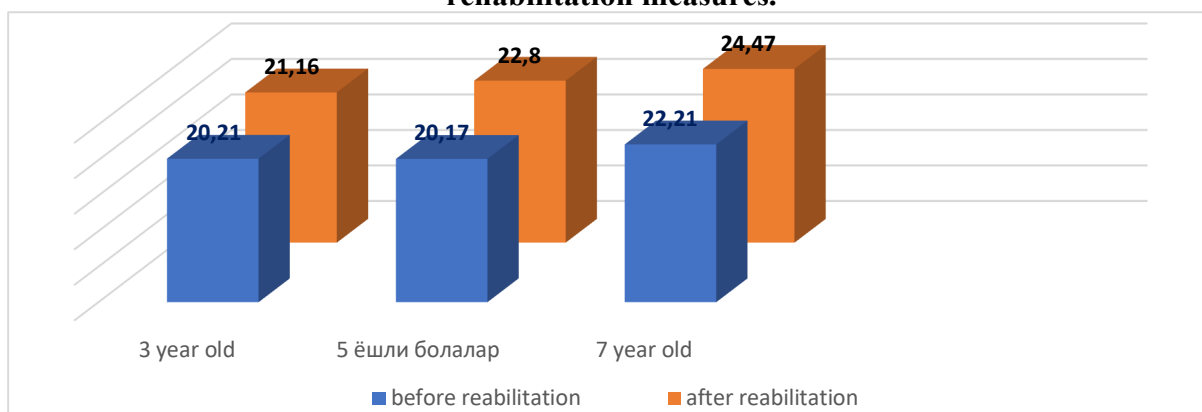
After the rehabilitation course, significant changes were noted in 94% of the examined children of the main group under the age of 12: the increase in leg length was  $3.5 \pm 0.4$  cm, and on average –  $99.5 \pm 0.5$  cm. Significant changes were found in 6% of the examined children, which amounted to  $97.7 \pm 0.3$  cm, while in the comparison group among 12-year-old children, small positive changes were found in 68% of children. The average length of their legs was  $95.6 \pm 0.4$  cm ( $p < 0.05$ ). 32 percent of respondents did not notice any positive changes and did not see a significant

improvement in their indicators. After rehabilitation measures in the main group, the length of the legs of children aged 13–15 years was  $105.5 \pm 0.5$  cm in 93% of the examined children. A slight improvement was observed in 7% of children: the length of the legs increased to  $103.8 \pm 0.6$  cm. After rehabilitation treatment, only 66% of children in the comparison group achieved an increase in leg length to  $100.5 \pm 0.7$  cm. No positive changes were found in 34 percent of the examined children. After rehabilitation procedures, 97% of children in the main group aged 16-18 years had a leg length increase of  $3.8 \pm 0.3$  cm and amounted to  $113.5 \pm 0.5$  cm, and 3% of children aged 16-18 years had a leg length of  $110.6 \pm 0.4$  cm ( $p < 0,05$ ). After the rehabilitation measures in the comparison group, 71% of children of this age showed an increase in leg length to  $108.2 \pm 0.4$  cm, while the remaining 39% of children did not show any positive changes.

The length of the left and right legs in patients of the main group did not change significantly ( $p < 0,05$ ). In the comparison group, the length of the right and left legs in children over 3 years old was  $0.3 \pm 0.02$  cm ( $p < 0,001$ ). The length of the right and left legs in children aged 5 years in the comparison group changed by  $0.4 \pm 0.03$  cm ( $p < 0,001$ ). In 7 year old children in the comparison group, it was noted that the length of the right and legs was  $0.2 \pm 0.02$  cm ( $p < 0,001$ ). The length of the right and left lower legs of the 8 year old children in the comparison group was  $0.3 \pm 0.01$  ( $p < 0,001$ ) cm, while the length of the right and left legs of the 9-10 year old children in the comparison group did not change in parallel. In children aged 11–12 years, the length of the right and left legs changed by  $0.3 \pm 0.02$  cm ( $p < 0,001$ ). The length of the right and left legs did not change much in children in the comparison group aged 13-15 years. In this group of 16-18 year old children, the length of the right and left leg changed by  $0.2 \pm 0.01$  cm ( $p < 0,001$ ) (Figure 3, 4).

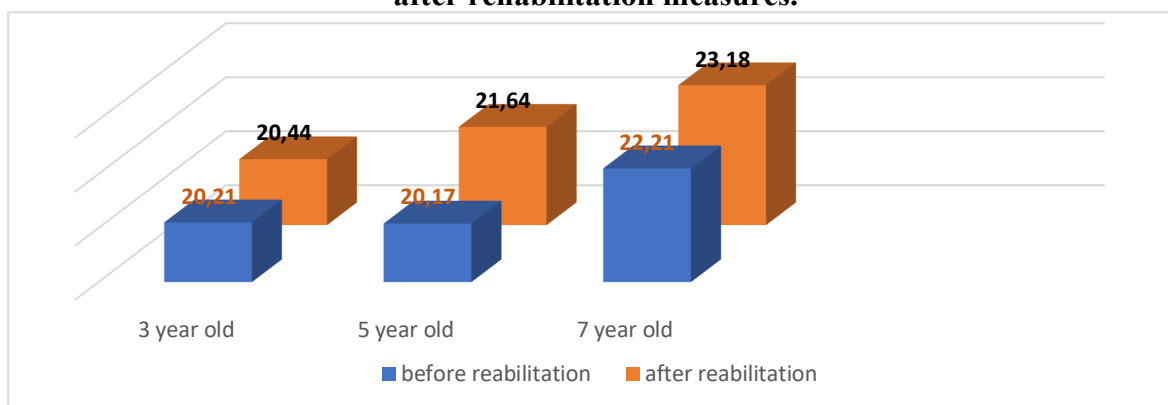
**Figure 3**

**Hip circumference indicators in children aged 3–7 years in the main group before and after rehabilitation measures.**



**Figure 4**

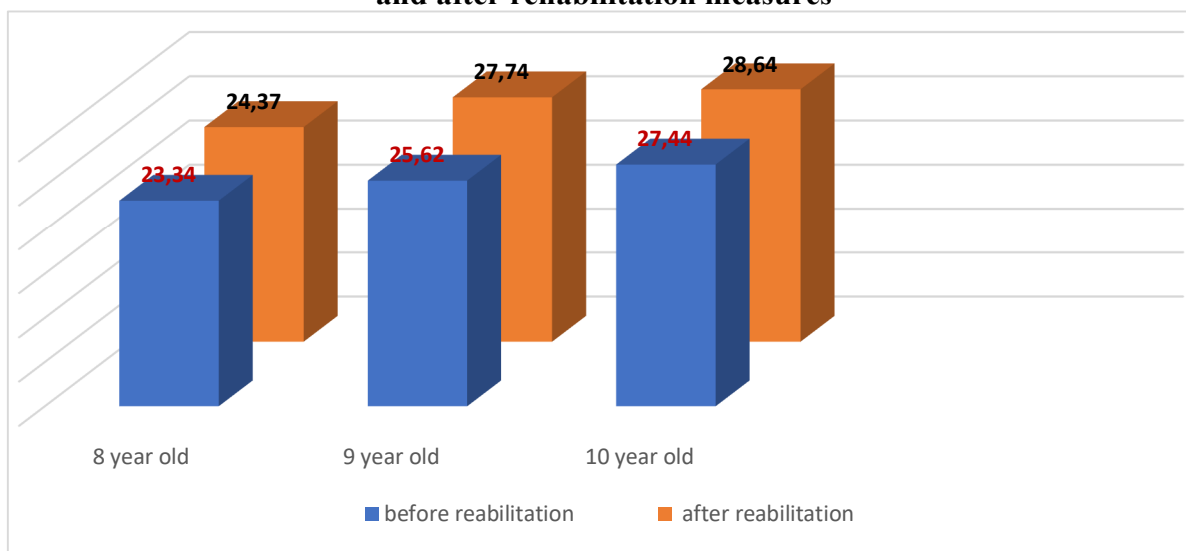
**Hip circumference indicators of children aged 3-7 years in the comparison group before and after rehabilitation measures.**



The average circumference of the lower leg in 8 year old children before the start of rehabilitation treatment was  $23.34 \pm 0.04$  cm ( $p \leq 0.002$ ), which corresponds to hypotrophy. After the rehabilitation procedures in the main group, significant positive changes were noted in 94% of children, and the average calf circumference was  $25.46 \pm 0.03$  cm ( $p \leq 0.002$ ). Minor changes were noted in 6% of children, the average thigh circumference was  $24.78 \pm 0.04$  cm ( $p \leq 0.001$ ). After rehabilitation, only 58% of children in the comparison group showed some improvement in the form of an increase in the average circumference of the lower leg by  $24.37 \pm 0.03$  cm ( $p \leq 0.001$ ). The remaining 42% showed no positive changes. In children under 9 years of age, the average calf circumference before rehabilitation was  $26.65 \pm 0.02$  cm ( $p \leq 0.001$ ). After the rehabilitation measures, positive dynamics were noted in 93% of children, and the thigh circumference indicators reached  $28.01 \pm 0.03$  cm ( $p \leq 0.001$ ). In the comparison group, only 66% of children showed minor changes, their thigh circumference was  $27.74 \pm 0.02$  cm. In 34%, no positive changes were found. In children under 10 years of age, the average calf circumference before rehabilitation was  $27.44 \pm 0.01$  cm ( $p \leq 0.001$ ). After rehabilitation treatment in the main group, in 97% of children, the thigh circumference was  $29.22 \pm 0.02$  cm ( $p \leq 0.001$ ). Minor changes were observed in 3% of children, the values of the calf circumference after rehabilitation treatment were  $28.79 \pm 0.03$  cm ( $p \leq 0.002$ ). After rehabilitation, the calf circumference in the comparison group was  $28.64 \pm 0.02$  cm ( $p \leq 0.002$ ) (Figure 5).

**Figure 5**

**Indicators of calf circumference in children aged 8-10 years in the comparison group before and after rehabilitation measures**



In children aged 11–12 years, the circumference of the lower leg before rehabilitation was  $28.37 \pm 0.02$  cm. After treatment, 91% of children in the main group had a calf circumference of  $30.04 \pm 0.04$  cm ( $p \leq 0.002$ ). A slight improvement was noted in 9% of children: the circumference of the lower leg increased to  $29.93 \pm 0.03$  cm ( $p \leq 0.001$ ). In the comparison group, a slight improvement was noted in 72% of those examined: the circumference of the lower leg increased to  $29.75 \pm 0.02$  cm ( $p \leq 0.002$ ). There were no found positive changes in 28 percent of children. The average lower leg circumference before rehabilitation in children aged 13–15 years was  $30.04 \pm 0.03$  cm ( $p \leq 0.003$ ). In the comparison group, 69% of children after rehabilitation had lower leg circumference values of  $31.94 \pm 0.06$  cm ( $p \leq 0.001$ ). No positive changes were found in 31% of the examined patients. The average lower leg circumference in children aged 16–18 years before the start of rehabilitation treatment was  $32.52 \pm 0.03$  cm ( $p \leq 0.001$ ). In the main group, after rehabilitation measures, the lower leg circumference in 90% of children was  $35.02 \pm 0.03$  cm ( $p \leq 0.002$ ). 10% showed a slight improvement with an increase in lower leg circumference to  $34.78 \pm 0.02$  cm ( $p \leq 0.001$ ). Only 78% of patients in the comparison group showed a slight improvement in lower leg circumference, which increased to  $34.33 \pm 0.02$  cm ( $p \leq 0.002$ ).

#### 4. Conclusion

During the examinations, patients with predominantly motor, sensory or mixed disorders were often identified. One patient had several types of complex lesions, representing pathological processes in different nerves. Differences in the sex and age of the examined patients depending on the type of nerve fibers were not taken into account. The majority of the subjects were included in the group of combined damage to several nerves in one patient (42%). The most common combination was damage to motor fibers, typical for ulnar neuropathy, with damage to the motor, mixed or sensory level. These infections are difficult to diagnose solely on the basis of patient complaints and clinical manifestations. It is important to study in detail the chronological sequence of the appearance of complaints and symptoms of the disease. The multi-stage nature of the lesion not only determines other treatment options, but may also influence the effectiveness of surgical treatment recommended for compression neuropathies. Referral from a local physician to a neurologist due to ineffectiveness of prescribed medications.

In the absence of adequate diagnostics, adequate treatment and rehabilitation programs, loss of mobility in this category of patients leads to a large number of disabilities. A thorough neurological examination and completeness of the ENMG examination allow us to identify neuropathy in a patient at different stages of the disease. It is necessary to regularly collect the results of orthoneurological examinations, ENMG, neuroimaging data (MRI, CT, ultrasound, radiography). Motor fiber damage was found to be significantly more common among both boys and girls (51.7% and 45.5%).

After treatment, positive dynamics of anthropometric indicators (leg length, shin circumference) were noted in children of the main group. Due to therapeutic exercise, massage and physiotherapeutic procedures, leg length increased by 4.5% ( $p < 0.05$ ), and thigh and lower leg circumference increased by 3.7%. ( $p < 0.05$ ). The control group showed fewer positive changes. Thus, the length of the legs increased by 0.7% ( $p < 0.05$ ), and the circumference of the thighs and lower leg increased by 1.3%. ( $p < 0.05$ ).

It is known that when physical exercises and muscle massage (therapeutic, segmental-reflex, point) are used as a therapeutic factor, the synthesis of glycogen and protein, and the consumption of nitrogen and oxygen are improved. Выполнение пассивных и активных движений является мощным афферентным и эфферентным стимулом, способствующим пролиферации нейронов в зоне функционального синапса и развитию новых путей передачи импульсов. A major advance in rehabilitation in recent years has been the recognition of the role of the phenomenon of “learned non-use” (“I forgot how to use it”). This term refers to anatomically intact neural circuits that disappear after long periods of inactivity. Like atrophied muscles, neural circuits lose their function if they are not used for movement.

At the same time, research shows that this is a reversible process: with the help of intensive training (physical education, occupational therapy), the functions of neural circuits can be restored even after decades of paralysis. Recently, methods of movement correction have been developed using multichannel functional electromagnetic stimulation of muscles, which is activated by mechanical movement in accordance with their natural excitation and contraction program.

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ЖУРНАЛ БИОМЕДИЦИНЫ И ПРАКТИКИ

ТОМ 10, НОМЕР 2

JOURNAL OF BIOMEDICINE AND PRACTICE

VOLUME 10, ISSUE 2

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