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# THE ROLE OF PREOPERATIVE PREPARATION AND POSTOPERATIVE REHABILITATION OF CHILDREN WITH HIP JOINT PATHOLOGIES

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**Abstract**
The most common cause of disability in children with musculoskeletal disorders are dysplastic hip instability disorders, which include: hip dysplasia, congenital subluxation, and congenital and pathological hip dislocation.

**Keywords**: Hip joint, congenital hip dislocation, pathological hip dislocation, pathological hip dislocation, rehabilitation.

## Introduction

The most common cause of disability in children with musculoskeletal disorders are dysplastic hip instability disorders, which include: hip dysplasia, congenital subluxation, and congenital and pathological hip dislocation. Musculoskeletal disorders rank fifth in the disability structure of the child population, primarily due to hip pathology (L.P. Grishina, 2005, V.O. Krysanov, 2006) [5]. According to the literature, the incidence of congenital pathology ranges from 0.15 to 4.45 cases per 1000 newborns [7,15]. Congenital hip dislocation is a serious injury; even after proper functional treatment, complications are common [1,5,7]. One of the most serious complications is aseptic necrosis of the femoral head, which significantly prolongs the recovery period for children and largely determines the functional and anatomical outcome. The incidence of this complication, according to various authors, ranges from 10% to 80% [1,6,9,20]. Orthopedic consequences of hematogenous osteomyelitis in children develop in 22-71.2% of children, in 16.2-53.7% of patients they lead to early disability [2,10,12,13] and are characterized by damage to the epiphyses, metaphyseal growth zones, metaphyses and diaphyses of long tubular bones, secondary changes in the soft tissues of the affected segment of the limb requiring long-term treatment, which is often explained by the need for repeated surgery due to recurrence of deformity [3,4]. Pathological dislocation of the hip is one of the most frequent and formidable complications of arthritis of the hip joint in children, arising against the background of acute hematogenous metaepiphyseal osteomyelitis of the proximal end of the femur in the neonatal period. According to H. Z. Gafarov et al. (1997), Shikhabudinova P.A. (1999)



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pathological hip dislocation occurs as a consequence of hematogenous osteomyelitis in 24.6% - 86% of cases [4]. A distinctive feature of the listed diseases of the hip joint is the disruption of local blood circulation due to various causes, both congenital and acquired, which ultimately leads to degenerative processes in the epiphysis of the head of the femur and the acetabulum, resulting in deformations of bone structures with impaired joint function [11,19,20]. Treatment of hip joint pathology in children and adolescents remains one of the leading problems of orthopedics. Surgeons are faced with the task of correcting defects in joint development, such as pathology of the spatial position of the joint components - the proximal end of the femur and the acetabulum, impaired development of the "roof" of the acetabulum, deepening of the acetabulum itself. Even with the most modern methods of conservative and surgical treatment of this pathology, residual deformities of the hip joint persist. These defects lead to the development of dysplastic coxarthrosis. According to some authors, 40 to 80% of coxarthrosis cases are a consequence of untreated hip dysplasia [8]. In adult patients, 30-40% of hip arthrosis cases are a consequence of such dysplastic diseases of the hip joint that were not fully treated in childhood, such as congenital hip dislocation, aseptic necrosis of the femoral head after conservative reduction of congenital hip dislocation, and pathological hip dislocation after hematogenous osteomyelitis. Postoperative rehabilitation of children with hip pathologies is a pressing issue in pediatric orthopedics. The issue of rehabilitation treatment for children with hip joint pathologies is currently receiving considerable attention, as it is a key element in comprehensive treatment and is crucial for improving treatment outcomes [11]. Surgical treatment of this hip joint pathology is the only radical treatment option and represents an extremely complex and unresolved issue in pediatric orthopedics. It should ensure hip joint stability to improve the patient's statics and gait, and, where possible, restore the supporting function of the limb while maintaining joint mobility, followed by addressing secondary deformities and equalizing the length of the lower limbs. Numerous unresolved issues remain regarding the conservative and surgical treatment of this pathology, as well as effective rehabilitation [4-9]. Following hip surgery and restoration of normal anatomical relationships, entirely new biomechanical and functional conditions arise. The outcome of the surgical intervention is influenced by competent preoperative planning, correct implementation of the procedure, and subsequent adequate rehabilitation. Preoperative preparation and postoperative rehabilitation for children with hip pathologies include therapeutic exercise, massage, physiotherapy, and medications that improve joint nutrition. To date, a significant number of studies have been conducted on the surgical treatment of hip pathologies, but many issues remain highly controversial or poorly understood. These include, first and foremost, the selection of the optimal age and method of surgical intervention, the duration of plaster immobilization, physiotherapy techniques, and the initiation of weight-bearing on the operated limb.

**Objective**:

To evaluate the effectiveness of preoperative preparation and rehabilitation measures in children after surgical treatment of hip pathologies.

**Materials and Methods**

The analysis of the results of surgical and restorative treatment of 114 patients (72 girls and 42 boys) aged 3 to 14 years for the period from 2022 to 2025 was conducted. Of these, 49 patients with



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congenital hip dislocation; 28 patients with multiplanar deformities of the proximal femur in aseptic necrosis after conservative reduction of congenital hip dislocation and 37 patients with pathological hip dislocation after hematogenous osteomyelitis. Preoperative preparation and examination of patients were carried out according to the generally accepted methodology. In the preoperative period, the following were performed: clinical examination, X-ray, MSCT research methods and a complete examination of the condition of all organs in order to identify concomitant diseases that may be a contraindication to surgical intervention. To assess the anatomical and functional state of the affected hip joint, clinical, radiological, and MSCT examination methods were used. The clinical examination included examining the patient from the front, back, standing, and supine, measuring limb length, and assessing gait. For radiographic examination of children, hip radiographs were taken in the anteroposterior projection with the hips in midposition, with internal rotation and abduction of the lower limb. Patients with aseptic necrosis of the femoral head demonstrated multiplanar deformity of the proximal femur, hip dislocation and subluxation, varus or valgus deformity and shortening of the femoral neck, valgus deviation of the epiphysis, a high position of the greater trochanter, and a negative articulotrochanteric distance. On radiographs, the following parameters were measured that characterize the angular values of the hip joint and the proximal femur: the angle of vertical inclination of the acetabulum, the angle of vertical conformity, the acetabular angle, the neck-shaft angle, the angle of anteversion, the Alsberg angle, the bone coverage coefficient, and the parameters that characterize the ratio of the femoral head and the greater trochanter in the frontal plane: the articulo-trochanteric distance, the trochanteric-trochanteric distance, the articulo-inferior distation. The indication for corrective osteotomies was a combination of clinical and radiographic data: lameness, malposition of the lower limbs, significant limitation of hip abduction, gluteal weakness, hip joint malalignment, hip subluxation, and proximal femoral deformity (coxa valga (caudal position of the greater trochanter), coxa vara (cranial position of the greater trochanter), coxa breva, relative overgrowth of the greater trochanter, and coxa magna), rather than the shortening of the lower limb itself. During this period, it is important to determine the patient's tolerance to antibiotics and anesthetics. The standard examination includes: complete blood count, urine, and stool tests, a biochemical blood test, blood type and Rh factor determination, Hbs antigen, ALT and AST blood enzyme determination, an electrocardiogram with transcript, a chest X-ray, an ultrasound of the internal organs, and examinations and reports from a pediatrician and anesthesiologist regarding the feasibility of surgery. The evening before surgery, a bowel cleansing enema or the "KLIN ENEMA" bowel cleansing solution should be performed.

We used the following types of surgical interventions: open reduction of hip dislocation with corrective intertrochanteric osteotomy and acetabular roof plasty according to Pemberton in 49 children (Fig. 1); open reduction of the stump of the head and neck of the femur with intertrochanteric detorsion-varus and shortening osteotomy of the femur with modulation of the stump of the head and neck in 37 children (Fig. 2) and extra-articular or open centering of the femoral heads with intertrochanteric detorsion-valgus-posterior rotation osteotomy of the femur and transposition of the greater trochanter of the femur in 28 children (Fig. 3).



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Fig. 1. Congenital hip dislocation. Condition after open reduction with intertrochanteric detorsion-varus and shortening osteotomy of the femur and Pemberton acetabuloplasty.

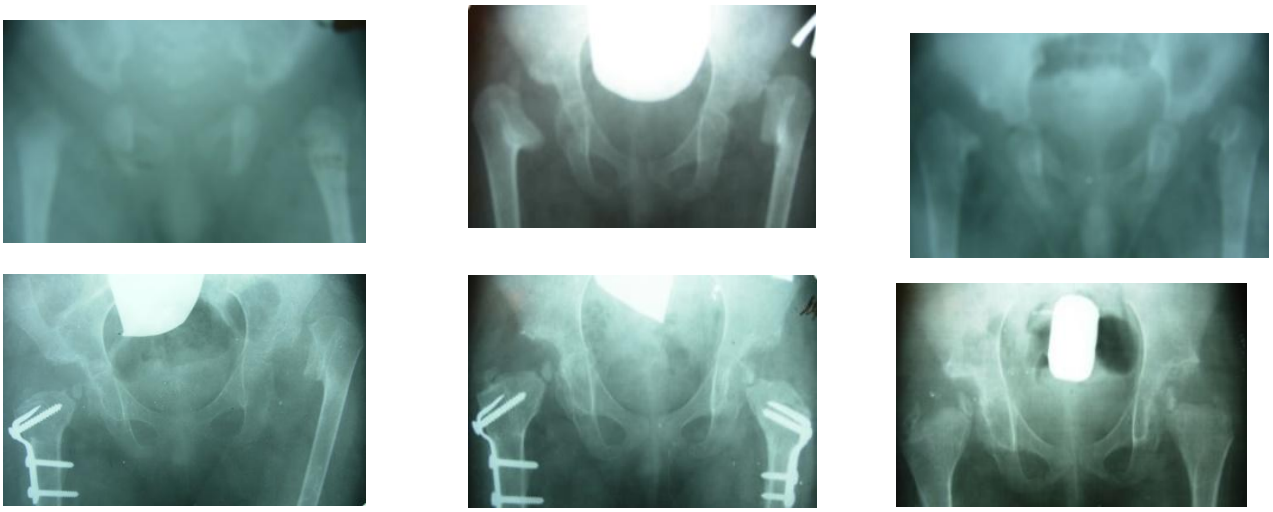

Fig. 2. Complication after osteomyelitis. Pathological destructive dislocation of the hips. Condition after open reduction of the femoral head and neck stump with intertrochanteric detorsion-varus and shortening osteotomy of the femur with modulation of the femoral head and neck stump.

The goals of rehabilitation measures were: pain relief, reduction of postoperative wound healing time, prevention of vascular disorders in the joint, elimination of post-immobilization muscle contractures, restoration of muscle trophism and range of motion in the lower limb joints, consolidation of bone fragments at the osteotomy level, preparation of the patient for verticalization, and teaching correct gait. Postoperative fixation was achieved with a one-and-a-half coxite plaster cast applied with the femoral head centered in the acetabulum. Rehabilitation treatment was divided into four stages: Stage I - early postoperative; Stage II - 6 weeks postoperative; Stage III - 5-6 months postoperative; Stage IV - 9-10 months postoperative.

During the early postoperative stage, therapy was administered to prevent and treat pathological changes in the general and local status caused by the severity of the surgical intervention. Antibiotic therapy was prescribed to prevent possible purulent complications from the postoperative wound. Pain management, infusion therapy to restore circulating blood volume, vitamin therapy, and symptomatic therapy were administered. Daily dressings were applied to the postoperative wound. A series of therapeutic exercises, including breathing exercises and active isometric contractions of the lower extremity muscles, was performed from the first days. Stage II began after the appearance of initial bone fragment consolidation on the control radiograph (6 weeks postoperatively), with the removal of the one-and-a-half coxite plaster cast and the application of a plaster boot with a derotator



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for 3 months. Rehabilitation measures during this period were aimed at stimulating bone fragment consolidation at the osteotomy level and developing range of motion in the hip and knee joints. To restore range of motion in the hip and knee joints, appropriate therapeutic exercise programs were performed, consisting of passive and active movements. Initially, with the assistance of a therapist, passive movements were performed to increase hip flexion, abduction, and rotation, and knee flexion. After 7-10 days, active exercises were progressed. To improve vascular and neurotrophic function, electrophoresis with aminophylline or nicotinic acid solutions was administered to the lumbosacral spine. Massage and electrical stimulation of the lower extremity muscles were performed, as well as paraffin applications to the hip and knee joints of the operated limb. Physiotherapy was administered in courses of 10 to 15 sessions, spaced 2.5 to 3 months apart, for the first year after surgery.

Stage III of rehabilitation treatment began 5-6 months after surgery. Therapeutic exercises and physiotherapy procedures continued. Control radiographs of the hip joints were taken. If radiographic changes were positive and unilateral pathology was present, walking with crutches was permitted, without putting weight on the operated limb. In case of bilateral pathology, the decision to allow walking was made on an individual basis and depended on the condition of the contralateral joint. Five to six months after surgery, all patients were allowed to sit with limited time—during transportation, meals, and homework. Riding a tricycle or using a stationary bike was permitted. Six to eight months after surgery, if radiographic evidence of complete consolidation of bone fragments was present, metal structures were removed from the proximal femur and iliac wings. A graduated axial load on the hip joint was prescribed, consisting of actively pressing the foot of the operated limb against a springy support (a rubber ball, a piece of foam rubber, etc.). Exercises were performed in the supine position. After removal of the metal structures, electrophoresis with angioprotectors and microelements to the area of the operated hip joint, as well as to the thoracolumbar spine, was added to the physiotherapy procedures. The following angioprotectors were prescribed: euphyllin or trental to the lumbosacral spine; nicotinic acid to the hip joint. Microelements prescribed to the hip joint included: calcium, phosphorus, and sulfur; calcium, sulfur, and ascorbic acid; zinc and sulfur. Drug therapy included chondroprotectors and vitamins (Vitrum Ca, E, and B12), administered orally in age-appropriate doses along with the initiation of electrophoresis with one of the angioprotectors and discontinued two weeks after its completion.

Stage IV of the recovery period began when full weight-bearing was permitted on the operated limb and continued throughout the entire observation period. In most cases, children were allowed full weight-bearing 10–12 months after surgery. A mandatory condition was radiographic confirmation of hip joint stability, joint space clearance, and restoration of normal pelvic bone structure and femoral head. Weight-bearing on the operated limb was increased gradually. Initially, the child began to partially bear weight on the leg while walking with two crutches. If there were no complaints of fatigue or pain, walking with one crutch was permitted, and then without crutches, with full weight-bearing. If a limb was shortened by more than 2 cm, it was compensated for with an orthopedic insole or a heel pad. A follow-up X-ray was taken three months after the patient began walking independently.



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**Results and Discussion**

The treatment results were analyzed for a period from 8 months to 6 years. In the preoperative period, the following were performed: clinical examination, radiographic, MSCT methods of research and a complete examination of the condition of all organs in order to identify concomitant diseases that may contraindicate surgical intervention. To assess the anatomical and functional state of the affected hip joint, clinical, radiographic and MSCT methods of research were used. The choice of the surgical method depended on the patient's age, the nature of hip joint stability disorders, the extent of destruction of the head, neck of the femur and acetabulum, the degree of hip displacement. The following types of surgical interventions were used: open reduction of hip dislocation with corrective intertrochanteric osteotomy and acetabular roof plasty according to Pemberton in 49 children; Open reduction of the femoral head and neck stump with intertrochanteric detorsion-varus and shortening osteotomy of the femur with modulation of the head and neck stump in 37 children and extra-articular or open femoral head centration with intertrochanteric detorsion-valgus-posterior rotation osteotomy of the femur and transposition of the greater trochanter of the femur in 28 children. In the postoperative period, all patients had their lower limbs fixed with a one-and-a-half coxite plaster cast applied in the position of femoral head centering in the acetabulum. After the appearance of initial bone fragment consolidation signs on the control radiograph (5-6 weeks after surgery), the one-and-a-half coxite plaster cast was removed and a plaster boot with a derotator was applied for a period of 2-3 months. To restore range of motion in the hip and knee joints, appropriate therapeutic exercise programs were performed, including passive and active movements. If radiographic changes were positive and unilateral pathology was present, walking with crutches was permitted, without weight-bearing on the operated limb. In case of bilateral pathology, the decision to allow walking was made on an individual basis and depended on the condition of the contralateral joint. Five to six months after surgery, all patients were allowed to sit with limited time—during transportation, meals, and homework. Riding a tricycle or using a stationary bike was permitted. Six to eight months after surgery, if radiographic evidence of complete consolidation of the bone fragments was present, metal structures were removed from the proximal femur and iliac wings. Follow-up examinations by a pediatric orthopedist and hip X-rays were performed at least twice a year. Clinical and radiographic follow-up is conducted annually for two years, and then every two years thereafter. The first signs of coxarthrosis are noted from the age of 9 years, and the highest percentage occurs between the ages of 12 and 16 years. It has been noted that the older the child at the time of surgery and the more traumatic the intervention itself, the faster the arthrosis develops. Coxarthrosis most often occurs and is severe after aseptic necrosis of the femoral head and destructive pathological hip dislocation, with significant deformation of the head and neck: coxa magna, coxa breva, coxa vara, and a high position of the greater trochanter of the femur. The requirement for reconstructive surgery was the preservation of cartilaginous structures, growth plates, and sufficient blood supply to the hip joint. Much attention was paid to predicting changes in joint relationships after surgery, taking into account the remodeling of its components during the child's growth.

**Conclusion:**

Preoperative preparation and examination of patients were performed according to the generally accepted methodology. The preoperative period included a clinical examination, radiographic, MSCT

methods of examination, and a complete examination of the condition of all organs in order to identify concomitant diseases that may contraindicate surgical intervention. Clinical, radiographic, and MSCT methods of examination were used to assess the anatomical and functional state of the affected hip joint. Clinical examination included: examination of the patient from the front, back, standing, and lying down, limb length measurement, and gait assessment. For radiographic examination of children, radiography of the hip joints was performed in the anteroposterior projection with the hips in the midposition, with internal rotation and abduction of the lower limb. Dynamic monitoring of children after surgery and the rehabilitation carried out were based on early initiation, continuity, consistency, comprehensiveness, and individual orientation, which ensured a lasting positive effect and significantly influenced the outcome of the disease. Children and adolescents undergoing surgical treatment for hip pathology require particularly close monitoring of their hip joint development. This is because the development of the hip joint with dysplastic changes, even with timely femoral head centering, continues for many years. Therefore, they should be monitored by their attending orthopedist until the age of 18, as only through the combined efforts of a local orthopedist, pediatrician, and rehabilitation physician can good long-term results be achieved.

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