MINISTRY OF HEALTH OF THE REPUBLIC OF UZBEKISTAN
BUKHARA STATE MEDICAL INSTITUTE

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UDC: 616.72-002.77:616.728.2-089

Akramov Vohidjon Rustamovich

OPTIMIZATION OF TREATMENT AND REHABILITATION METHODS FOR PATIENTS WITH ASEPTIC NECROSIS OF THE FEMORAL HEAD

BUKHARA - 2024

Compiled by:

Akramov Vohid Rustamovich – Associate Professor of the Department of Traumatology and Neurosurgery of the Bukhara State Medical Institute, DSc .

Reviewers:

1. **Norov A.U. - Associate Professor of the Department of Otorinolaringologiya of the Bukhara State Medical Institute, DSc .**
2. **Xamrayev A.SH. - Professor of the Department of Traumatology and Orthopedics of the TTA, Doctor of Medical Sciences.**

TABLE OF CONTENTS

INTRODUCTION

According to the World Health Organization, the incidence and disability rates due to degenerative-dystrophic pathology of the hip joint are still high, the proportion of aseptic necrosis of the femoral head (ANFH) is 1.2-4.7% of all degenerative-dystrophic diseases of this joint, with 75 to 100% of cases occurring in working-age patients. Long-term disability and a high proportion of disability make ANFH one of the most pressing areas of orthopedics and traumatology. Most often, avascular necrosis of the femoral head occurs in patients aged 35-45 years, with men suffering 3 times more often than women. In the United States, up to 20,000 new cases of ANFH are diagnosed annually. In 50-75% of cases, the disease is bilateral, which causes disability in young patients and severe impairment of the function of the lower extremities [1].

As a result of the study, various solutions were obtained to improve the diagnosis and treatment of aseptic necrosis of the femoral head. Various techniques of bone plastic surgery, decompressing, leading to improved blood circulation in the femoral head were proposed. To date, the use of conservative methods of treating ANFH does not lead to good results. The lack of study of the problem of treating pain syndrome in ANFH, maintaining the integrity of the femoral head by conservative methods of treatment, by using plasma lifting and neuroablation in a large number of patients, as well as early use of endoprosthetics leads to repeated endoprosthetics of the hip joints. Not taking into account the stage of the disease during the treatment of patients, the lack of a differential approach makes the problem very urgent.

In our country, special attention is paid to improving the healthcare system, in particular, improving the quality of diagnostics, treatment and prevention of various

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[1] Loskutov A.E., Oleynik A.E., Altanetz A.V. Evaluation of the state of the acetabulum in aseptic necrosis of the femoral head based on X-ray morphometric studies // Trauma. 2014. No. 1. URL: https://cyberleninka.ru/article/n/otsenka-sostoyaniya-vertluzhnoy-vpadiny-pri-asepticheskom-nekroze-golovki-bedrennoy-kosti-po-dannym-rentgenmorfometricheskih.

orthopedic and traumatological diseases. The Strategy of Actions for the Further Development of the Republic of Uzbekistan for 2017-2021 provides for tasks to raise the level of medical care to a new level "... increasing the efficiency of providing medical care to the population, improving quality, as well as forming a system of medical standardization of diagnostics and introducing high-tech treatment methods ... " [2]. It follows from this that scientific research aimed at developing prediction and improving the results of hip arthroplasty is considered appropriate.

This dissertation research to a certain extent serves to fulfill the objectives approved by the Decrees of the President of the Republic of Uzbekistan "On the Strategy of Actions for the Further Development of the Republic of Uzbekistan" No. UP-4947 dated February 7, 2017, "On Measures to Further Improve the Emergency Medical Care System" No. UP-4985 dated March 16, 2017, "On Comprehensive Measures to Radically Improve the Healthcare System of the Republic of Uzbekistan" No. UP-5590 dated December 7, 2018, the Resolution "On Measures to Further Develop Medical Care to the Population of the Republic of Uzbekistan" No. PP-5198 dated July 26, 2021, and other regulatory documents adopted in this area.

CHAPTER 1. A MODERN VIEW OF DIAGNOSTICS AND TREATMENT OF PATIENTS WITH ASEPTIC NECROSIS OF THE FEMORAL HEAD (LITERATURE REVIEW)

§ 1.1. Epidemiology, clinical features and risk factors of aseptic necrosis of the femoral head.

Osteonecrosis of the femoral head (ONFH) is a pathological condition with multiple possible etiologies, which is characterized by bone marrow damage and osteocyte death. This leads to progressive destruction of the hip joint. The disease can be divided into traumatic and non-traumatic. Non-traumatic, as the main type, is characterized by significant pain and often leads to hip arthroplasty.

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[2] Decree of the President of the Republic of Uzbekistan “Strategy of Actions for further development of the Republic of Uzbekistan" No. UP - 4947 dated February 7, 2017.

It has been reported that in the United States, the incidence of non-traumatic types may be up to 20,000 cases per year [31; 32; 33]. It has been shown that the total number of non-traumatic patients in China was 500 to 700 million [4 , 10, 42 , 66]. Recently, more and more researchers have been investigating this disease worldwide. In South Korea, an epidemiological study showed that the prevalence was estimated to be 28.91 per 100,000 [4 , 10]. In Japan, the prevalence was about 8.93 per 100,000 in 2004 [4 , 67 , 102] There are 2,500–3,000 new cases reported annually in Japan [31 , 32], 15–20,000 new cases in the United States [42 , 66], and 100–200,000 new cases in China [4 , 67 , 102 , 120]. Moreover, these numbers have been increasing in recent years. Until now, the most consistent research findings may have been disproportionately distributed among men.

Aseptic necrosis of the femoral head is a severe degenerative-dystrophic disease characterized by a violation of the processes of osteogenesis and resorption, a violation of the blood supply and a gradual deformation of the femoral head in places where the greatest load is applied to it. The relevance of the problem lies in the high disability that occurs as a result of the destruction of the joint, and quite high prevalence of this disease. In the Russian Federation, up to 4.7% of all orthopedic pathology of the hip joint is due to aseptic necrosis of the head. In 75% of cases, this pathology has a bilateral lesion, and men suffer from this disease in 5-6 times more often than women [1, 2].

According to foreign data, in the USA from 5 to 18% of primary total endoprosthetics are performed due to aseptic necrosis of the femoral head [3, 4]. Disability due to this pathology reaches 7% from degenerative diseases of the musculoskeletal system. The complexity of treatment is largely determined by the fact that the process can proceed asymptomatically until late stages, at which irreversible changes develop.

The prevalence of the process is due to its polyetiological nature. Currently, many risk factors are known development of necrosis of the head . Such factors include the use of corticosteroids, alcohol consumption, trauma, pathology of the hematopoietic system, decompression sickness, hyperuricemia, gout, HIV infection, oncological diseases [5-8]. It is usually impossible to single out one factor that would lead to the development of the disease [1, 9,10]. Foreign authors pay more attention to the traumatic factor, as a result of which a fracture of the bone beams initially occurs, a disruption of blood flow in the arteries that feed the articular parts of the bones. Especially This is significant during the growth period [4, 6,11, 12].

When studying works devoted to the pathogenesis of the disease, three main theories can be distinguished: vascular disorders; neurotrophic disorders; anatomical and functional changes (congenital or acquired at an early age).

The vascular theory considers both arterial changes and venous stasis as a trigger for capillary tamponade, which in turn leads to ischemia of certain bone areas. The neurotrophic theory provides for a primary disruption of the innervation of the vessels that feed the femur areas, which already leads to vascular dysfunction. The anatomical and functional theory considers disruption of the load axis on the articular surfaces as a trigger for the development of aseptic necrosis.

Of course, all these theories are valid, and at present they are the main ones, which is confirmed by new data [1,13]. One of the reasons for the development of severe complications of aseptic necrosis of the femoral head is the difficulty of diagnosing this disease in the early stages. On the one hand, this process proceeds asymptomatically for a long time and appears only after the development of the collapse of the femoral head, and on the other hand sides – in the initial stages of the disease, primary radiological changes may be delayed, creating the impression of the absence of joint pathology [2, 9].

Anamnesis collection is quite helpful in making a diagnosis. The presence of injuries in the past , the presence of bad habits in the patient can prompt the doctor to make a correct diagnosis. Until recently, the main diagnostic method was routine radiography of the joints. The most commonly used classifications of osteonecrosis are based on radiography data, although the effectiveness of this simple technique in the early stages is not high enough. Quite informative-

The most common method is joint scintigraphy, which allows determining the accumulation of radioisotope in tissues, but its availability is low, since radioisotope laboratories are not available in all cities. Computer tomography (CT) allows assessing the size of the pathologically altered area of the femoral head and early degenerative changes in the joint.

The most sensitive method for diagnosing avascular necrosis of the femoral head is magnetic resonance imaging (MRI). This type of research is considered the “gold standard” of non-invasive methods. MRI makes it possible to determine the stage of the disease, identify asymptomatic forms, assess the condition of soft tissues, and monitor the dynamics of treatment. Recently, even classifications taking into account MRI data [12].

The most common classification is based on clinical manifestations:

- I – periodic pain, especially at night, movements are preserved, additional support is not required;

- II – impression fractures – pain is almost constant , movement is limited, use of a cane, crutches;

- III – bone sequestration – constant pain, severe limitations of movement, muscle atrophy, constant use of a cane or crutches;

- IV – reparation or secondary arthrosis – pain during movement, relative shortening, severe lameness.

According to the classification, Ficat and Arlet distinguish 4 stages of aseptic necrosis depending on radiographic manifestations. At stage I, radiographic examination does not reveal any pathological manifestations in the bone tissue of the femoral head. At stage II, the contours of the femoral head remain normal, but cystic changes and areas of osteosclerosis appear. At stage III, subchondral collapse of the spongy substance and flattening of the femoral head are radiographically detected. At stage IV, the joint space narrows, secondary degenerative and dystrophic changes appear in the acetabulum [14, 15]. Currently, the ARCO classification has become widely popular, which takes into account the results of MRI and scintigraphy and correlates with clinical manifestations.

The ARCO classification distinguishes 5 stages of the disease [14].

At 0 stages, all diagnostic data are within normal limits, pathological changes are detected only by histological examination. At stage I, osteonecrosis is detected by scintigraphy and magnetic resonance imaging (MRI). Radiography does not reveal pathological changes. At stage II, radiography determines irregular margins of the femoral head, osteosclerosis, cystic changes or signs of osteopenia, but without manifestations of collapse of the superficial parts of the bone on scintigraphy. Stages I and II are divided into three types: A (less than 15% of the femoral head is affected), B (15-30%) and C (more than 30%).

Stage III, characterized by the presence of head collapse, is divided into types depending on the degree of articular impression surfaces of the upper pole: A (less than 2 mm), B (2–4 mm), C (more than 4 mm). At stage III, the presence of crescents is noted, indicating that the subchondral plate is delimited from the necrotically affected spongy bone. These crescents are detected both on MRI and on scintigraphy. Stage IV is characterized by destruction of both the femoral head and the acetabulum with secondary arthritis [12].

All methods of treating this pathology can be divided into conservative and surgical. As a rule, conservative methods are used as the main ones in the early stages of the disease, when the process of destruction can be reversible. The main goal of treatment is to improve blood circulation in the hip joint area, reduce the load on the joint:

1. Unloading the sore limb. Moving the patient with support

on a cane or crutches are effective only in the early stages of the disease (Ficat and Arlet I-II), when the osteonecrosis focus occupies less than 15% of the head tissue and is located in a non-load-bearing zone.

2. Use of bisphosphonates . Bisphosphonates are osteoclast inhibitors and slow down the processes of bone resorption in the necrotic zone [6, 16].

3. Use of anticoagulants and statins Use of anticoagulants effective in the early stages of the disease. The result of their action is an improvement in blood flow by reducing thrombosis of the arteries and veins of the bone tissue of the head [16].

The use of statins (lipid-lowering drugs) is most justified in steroid-induced osteonecrosis. In this case, pronounced hypertrophy of fat cells in the spongy substance occurs with impaired blood outflow.

4. Extracorporeal shock wave therapy and pulsed electromagnetic therapy. The exact mechanism of their therapeutic effect on the disease is unknown, but some research studies have shown their positive effect on osteogenesis and angiogenesis [8, 17].

5. Hyperbaric oxygenation. Reduces intraosseous pressure and improves microcirculation in the spongy substance of the femoral head.

6. Use of cells that stimulate vasculogenesis and osteogenesis.

Experimental studies on animals have shown the positive effect of CD34+ cells. After intravenous administration of these cells, improvements in the processes of vasculogenesis and osteogenesis were noted [18].

However, conservative treatment methods are effective only in the early stages of the disease, so they are currently used more as an adjunct.

Surgical treatment methods are usually used at the stages of clinical manifestations, when irreversible changes have already occurred, and are either palliative or radical (endoprosthetics). Unfortunately, surgical interventions that would be of a preventive nature are rarely performed, since patients come to the orthopedist's attention late. Of the surgical methods, it is possible

highlight the following groups:

- decompressive operations on soft tissues, which reduce bone ischemia by dissecting the joint capsule or broad fascia of the thigh. The most well-known is the Voss operation. Such operations are often supplemented by tenotomy of the gluteal muscles or tenotomy of the adductors. These interventions are usually palliative in nature and provide a temporary effect [19, 20];

- osteotomy of the proximal femur. The main principle of osteotomy of the proximal femur in case of necrosis of the femoral head is to remove the load from the necrosis zone and transfer the mechanical load to the unaffected part of the head.

The most well-known are the Powells and Sugioka operations. These operations, performed at the initial stages of the disease, allow for positive results in 70-80% of cases [11, 21, 22]. These operations can be classify as independent radical interventions, provided there are correct indications;

- bone decompression with bone autografting. These operations involve a combination of the positive factor of decompression with improved bone vascularization. Such interventions are performed with vascularized transplants (usually from the fibula or ilium) or with free transplants [4, 13, 23-25].

IN Recently, operations that use allografts or a free vascular bundle have become popular [2]. These operations can also be classified as radical ;

- auxiliary operations. These include the method of intraosseous stem cell administration, plastic surgery of bone cavities with porous metals. These operations are not yet widely used;

- joint endoprosthetics. Certainly, in recent years this has been the most effective and frequently used operation.

Endoprosthetics immediately allows you to restore painless movements in the joints , but it is not without its drawbacks.

The main reason is that femoral head destruction is a disease of young people, so almost all patients live to the point where problems associated with wear of implants, development of age-related osteoporosis, etc. begin to appear.

In addition, there are problems of infection, periprosthetic fractures, etc., which somewhat limits the spread of endoprosthetics in young people [1, 2, 4, 11, 18,26].

All these factors force researchers studying the problems of aseptic necrosis of the femoral head to look for new methods of diagnosis and treatment of this serious joint lesion.

A Japanese study found that the ratio between men and women was around 3:2 [4, 67, 102, 12 0]. Moreover, a study conducted in South Korea found that the ratio was around 7:3 [14, 49, 90].

Although the etiology has not been definitively proven, risk factors include alcohol consumption, corticosteroid use, and bleeding disorders. It has been shown that non-traumatic patients with accounted for more than 70% of all patients. [*15* , *21*] Most of these cases are caused by alcohol and steroid use. The remaining cases are considered as idiopathic induced patients with unclear etiology, such as slipped capital femoral epiphysis, systemic lupus erythematosus, HIV infection, and hyperlipidemia. [27 , 28 , 155] Fukushima et al. reported that steroid use (51%) was the main etiology in Japanese [4 , 67 , 102, 120], but Kang et al. reported that in South Korea, most of the non-traumatic patients with belonged to idiopathic patients (51.4%). [*34* , 55 , 71] There were 5126 (70.5%) male patients with a mean age of 44.5 years and 2142 (29.5%) female patients with a mean age of 47.6 years. The mean age of female patients was 3.1 years older than that of male patients, indicating an earlier onset of nontraumatic in male patients. Analysis of the etiology of nontraumatic showed the role of steroids and alcohol as the cause in 77.9% of cases in males and 71.9% of cases in females. However, the underlying etiology was different in male and female patients. For males, the underlying etiology was alcohol use (45.1%); however, in females, the underlying etiology was steroid use (49.4%). The most commonly used steroids were glucocorticoids and prednisolone. It has been reported that glucocorticoids can affect the metabolism of bone marrow stromal cells and induce adipogenesis in these cells, ultimately leading to non-traumatic .[*78* , 99 , 149]

The actual time of onset of osteonecrosis in systemic lupus erythematosus patients has been shown to be within the first month of high-dose corticosteroid treatment [81 , 103 , 156]. Continuous treatment with prednisolone (20 mg/day, 3 months; 60 mg/day, 1 month) may result in non-traumatic osteonecrosis. [84 ,95,153].

Alcohol can cause bone marrow necrosis, proliferation and hypertrophy of fat cells, decreased hematopoiesis, thinner and more sparse trabeculae, and an increase in the lacunae of empty osteocytes, all of which can be found in patients [3, 11, 46, 47]

Wang et al. used 9.2 g/kg/day ethanol to induce osteonecrosis in rabbits [93 , 124], and Broulík et al. used 7.22 g/kg/day of ethanol to induce bone metabolism disorders in rats. [*105* , 128 , 209] These animal studies showed a close relationship between alcohol consumption and osteonecrosis. Alcohol consumption was the main etiology in non-traumatic male patients. One study showed that chronic alcohol consumption (400 ml/week) may clearly increase the risk. [10 , 39 , 108] However, the exact amount of alcohol needed to induce non-traumatic osteonecrosis in humans is still unclear. In addition, we found that TG and LDL levels were significantly altered in patients with non-traumatic osteonecrosis caused by idiopathic diseases.

This finding is consistent with the hypothesis that osteonecrosis may have a close relationship with lipid metabolism. [179 , 205, 250] . Lipid metabolism disorders can increase the risk in the following ways. On the one hand, it can lead to a tendency for blood to clot in the tiny blood vessels of the femoral head and even to the formation of lipid emboli inside the vessels. These phenomena can affect the blood supply and eventually initiate pathology. On the other hand, it can cause an increase in fat cells in the bone marrow cavity and the accumulation of fat tissue, which leads to an increase in pressure in the bone marrow cavity. Then the blood supply is impaired, and finally arthrosis occurs. The study found different underlying etiologies in male patients (alcohol consumption) and female patients (steroid use).

Agadzhanyan V.V. and co-authors, 2016 wrote that pathological impulses from the focus of osteonecrosis of the femoral head can lead to a reflex spasm of the hip vessels and will be the cause of the development of DDD of the hip joint [9, 38, 98].

In this case, micro fractures of the bone beams are observed, after which compaction in the subchondral part appears in the upper outer anterior part of the femoral head [17, 127, 192].

According to some data, limited fibrous tissue is observed in the area of osteonecrosis. In the area of the femoral head, increased vascularization is observed around the osteological zone, and new elements of bone tissue appear in the sclerosis zone. The process also involves cartilaginous tissue in the acetabulum, and its progression to protrusion is observed. Deforming arthrosis of the hip joint is observed in the process of involvement of articular cartilage in the terminal stages [100, 176, 177].

Osteonecrosis affects both compact and cancellous bone in a limited area. The clinical picture of non-traumatic necrosis of the femoral head was first described more than 50 years ago. Currently, avascular necrosis (AVN) continues to be a serious clinical problem, as it mainly affects middle-aged patients in the active phase of life. Another aggravating factor is that 30–70% of patients have both hips affected, with the peak incidence occurring at 40 years of age [142, 238, 252].

In contrast to traumatic causes such as subcapital femoral neck fracture or hip dislocation leading to vascular rupture and acute perfusion deficit of the femoral head, the exact etiology of AVN remains unclear [140 , 119 , 230]. A multifactorial genesis is discussed, including several underlying diseases such as Gaucher disease , ionizing radiation, steroid therapy, as well as risk factors such as alcohol abuse, hyperuricemia, pancreatitis and pregnancy [82 , 106 , 131].

Bone necrosis can develop due to disruption of arterial blood supply, obstruction of venous outflow, obstruction of intraluminal capillaries and compression of capillaries in the bone marrow space.

disclosed to date . There are no scientifically proven factors in the literature on the origin of ANFH. According to some authors, anomalies in the development of blood vessels, excessive functional load, infectious diseases and cooling. Other authors believe that ANFH can be idiopathic and constitutional, genetic, i.e. overload with violence on damage to the femur against the background of a genetically determined defect [198, 239, 243].

The authors wrote that the origin of ANFH in approximately 80% of patients is non-traumatic, and only in 10-20% of cases is it truly idiopathic. In the development of ANFH, whatever the cause, ischemia is noted as the underlying cause [18, 44, 116].

The authors argue in the development of ANFH that the femoral head is sensitive to any ischemic fluctuations because it is a closed compartment. They described that when ischemia progresses , thrombosis of the vessels occurs against the background of increased intraosseous pressure and necrosis of the bone beams on the femoral head is observed, where the load is expressed [20, 53, 120].

According to Akhtamov R. et al. 2012, various etiological factors and mechanisms in the development of damage to the femoral head are assumed in the etiopathogenesis of ANFH. Particular attention is paid to the anatomical features of the femoral head. During the disease, patients experience cessation of adequate blood supply to the femoral head. Thus, there are no scientifically proven facts about the origin of ANFH in the literature [22, 73, 122].

According to some authors, the etiological causes are a combination of factors, such as neurovascular disorders, environmental influences, a special hormonal background , and also, in biomechanical terms, the structure of the hip joint is of great importance. Other authors believe that ANFH can be idiopathic, post-traumatic, or aseptic [23, 74, 121].

The clinical picture of ANFH is characterized by the first signs being minor pain in the hip joint and gait disturbance due to pain. Pain initially bothers the knee joint and hip joint. The authors indicate that the presence of pain in the knee joint and hip joint is explained by the fact that there are receptor fields formed at the level of L1 - L2 by afferent neurons of the spinal cord ganglia. Patients are bothered by pain that intensifies most by the end of the day and subsides at night. Periodically, the pain subsides. Over time, patients experience limited abduction and rotation of the hip joint. But also the development of shortening of the lower limb and deformation of the pelvis and spine [24, 104, 170].

According to the authors, the main clinical signs in all patients with ANFH are pain with joint , which intensifies at night. Pain during physical exertion is observed in the gluteal region and knee joint. Objective examination of patients reveals limited movement in the hip joint, hip rotation, abduction and flexion in the hip joint. Examination reveals hypotrophy of the muscles of the hip region. [111, 180, 243].

Gorokhovsky V.S. et al., 2012 described that the course of the disease can be differentiated into three stages. However, the authors did not take into account the last stages of the disease [25, 70, 130].

Aseptic necrosis of the femoral head, after suffering from covid syndrome, a significant number of patients experience severe pain syndromes of the musculoskeletal system, dysfunction of the joints , which leads to disability. In covid syndrome, the use of glucocorticoids often leads to impaired blood clotting and thrombosis of small vessels in the hip region, which is one of the causes of aseptic necrosis of the femoral head in patients who have suffered from covid syndrome. During the 2003 SARS epidemic, corticosteroids were believed to improve the patient's condition in the early stages by lowering temperature, reducing inflammatory infiltration of the lungs and improving oxygenation; however, long-term use (especially in high doses) is associated with potentially serious side effects.

In a subsequent study, 23.1% (18/78) of patients with atypical pneumonia developed steroid-induced postcovular avascular necrosis of the femoral head, mainly due to high-dose glucocorticoids during treatment for atypical pneumonia. In our region, the incidence of avascular necrosis has increased sharply in the past year due to the Covid-19 pandemic. (246 , 252).

The prognosis of untreated steroid-induced aseptic necrosis of the femoral head caused by corona virus is poor; it often leads to subchondral collapse in a short time. Timely diagnosis and treatment can preserve the function of the hip joint to the maximum extent only when detected in the early stages.

Akhtamov I.R. et al. (2012) propose ANFH of the fifth stage of disease development, which allows one to navigate the stage of the disease when choosing a treatment method. Thus, the division of disease stages is conditional, because the process develops dynamically, has no clear boundaries, and one stage passes into another. Such division of the stage of the disease is necessary to determine the degree and depth of the pathological process. These indicators decide on the choice and tactics of the treatment method.

In the world, every seventh man and every fourth woman over 45 suffers from hip joint arthrosis (coxarthrosis). In many cases, due to destructive changes in the joint, the pain becomes unbearable, and then the patient inevitably embarks on the path of joint replacement surgery, the method we offer is an innovative method of joint pain relief, which consists in "switching off" the painful nerve endings surrounding the joint: radiofrequency denervation (ablation). (240).

In our region, surgical treatment of aseptic necrosis of the femoral head mainly consisted of hip replacement, which was useful in the late stages of the disease. However, scientific studies on early diagnosis, comprehensive conservative and minimally invasive and stage-specific surgical treatment, study and implementation of research results after Covid-19 have not been conducted. (178 , 181)

The recent outbreak of coronavirus disease 2019 (COVID-19) has become a global epidemic. Corticosteroids are widely used to treat severe acute respiratory syndrome (SARS), and the pathological findings observed in severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are very similar to those observed in severe acute respiratory syndrome . coronavirus (SARS-CoV) infection. However, long-term use of corticosteroids (especially at high doses) is associated with potentially serious adverse effects, most notably steroid-induced avascular necrosis of the femoral head. Whether to use corticosteroid therapy, the dosage and duration of treatment, and methods of prophylaxis are all important issues in the context of the current global outbreak.(128, 153)

Corticosteroid use is considered one of the most common causes of ANFH. The pathogenesis of steroid-induced ANFH is not established, but proposed mechanisms include fat embolism, fat hypertrophy, hypercoagulable state, vascular endothelial dysfunction, and bone marrow stem cell abnormalities.(176)

There is no consensus on the dosage and duration of steroid use required to develop ANFH. Some authors report that a cumulative dose of 2000 mg (or equivalent) of prednisone is required to develop ANFH . Some studies have shown that 700 mg is the minimum dose required to develop ANFH.(176)

There is controversy regarding the time after steroid use to the development of symptoms of ANFH. In a case report of a 23-year-old male patient who developed ANFH after oral dexamethasone (equivalent to 700 mg prednisolone), the authors reported that the patient developed symptoms 2 years after steroid use. The mean time from corticosteroid use to the development of ANFH was 16.6 months (range, 6–33 months). (128, 153, 158).

The goal of treatment of ANFH is to relieve pain, slow down the progression of the disease, prevent collapse and restore joint function. Many treatment options are available for the treatment of ANFH, ranging from conservative, medical to surgical, however, there is no standardized protocol. Various medical treatments have been tried in the past. Therefore, arthroplasty remains the mainstay of treatment. Although it gives a good result, but if performed at a young age, it will require at least one revision in the future. The successful use of bisphosphonates for the treatment of ANFH in adults was first reported by many authors (58, 62). The authors showed that bisphosphonates not only give a good clinical result, but also slow down the progression of the disease and the need for surgical intervention. Subsequently, various authors published the role of bisphosphonates in the treatment of ANFH and now it is considered one of the standard treatment options for ANFH. (63, 64 , 92)

§ 1.2. Current issues in diagnostics of patients with aseptic necrosis of the femoral head

Diagnosis of ANFH in the early stages is often difficult. Some others note in the early stages of the disease a pathognomonic syndrome inherent to ANFH - progressive atrophy of the thigh muscles, gluteal muscles on the affected side [25].

Others point to the absence of pain in the hip joint in the early stages, limited movement, shortening of the limb on the affected side, flexion-adduction contracture, muscle atrophy on the affected side, and pelvic tilt [2].

The earliest symptoms of the disease include limitations of movement in the hip joint in various planes: limitations of rotational movements of the hip, especially internal rotation (80–85% of cases), accompanied by pain, then limitations of abduction are noted, and lastly, a decrease in flexion-extension of the hip.

The diagnostic capabilities of ANFH are expanded by radiography of the hip joint, computed tomography (CT), and MRI. Laser Doppler flowmetry and microsensor transducers of intraosseous pressure are used to study the blood circulation of the femoral head [28].

MRI diagnostics demonstrates the ability to assess changes in soft tissue structures, including hyaline articular cartilage, the presence of joint effusion and bone tissue edema, and allows for dynamic monitoring of osteonecrosis treatment [20].

Early signs of osteonecrosis, which corresponds to stage 0 of the process, can be detected only on dynamic MRI with contrast in the form of slowing down of contrast agent perfusion in the necrosis zone [15]. At the first stage of the process, a crescent-shaped band of low intensity of the M R signal can be detected in the subchondral layer of the femoral head [44]. At high magnetic field strength, MRI has a higher sensitivity than radionuclide scanning. Thus, using 1.5 T, Beltran et al. reported 88% sensitivity, 100% specificity and 94% accuracy of MRI compared with 78% sensitivity, 75% specificity and 76% accuracy of osteoscintigraphy [14]. The high sensitivity of MRI was confirmed by other investigators where the study was performed at 0.6 T and compared with single-photon emission CT (SPECT) bone imaging using technetium-99m (99m Tc) methylene diphosphonate (MDP) [37]. Magnetic resonance imaging had a sensitivity of 87% and a specificity of 83%, while SPECT scanning had a sensitivity of 91% and a specificity of 78%. Both diagnostic methods were more effective than planar bone scintigraphy, which had a sensitivity of 83% and a specificity of 83%.

Magnetic resonance imaging has been able to reveal significant differences between aseptic necrosis, bone marrow edema, and subchondral insufficiency in proximal femoral fractures, especially with respect to maximum allowable values (Emax), slope (Eslope), and peak time (TT P) [35].

Another diagnostic method, single-photon emission computed tomography (SPECT), can detect early stages of ANFH and provide a three-dimensional image of radioactivity in the target organ. Overlying and underlying areas of radioactivity can be separated into successive tomographic planes, providing increased image contrast and improved lesion detection and localization compared to scintigraphy.

It is used as an alternative to MRI when it is not possible to perform it or when the results of MRI are uncertain [36]. SPECT images reflect the integrity of the vessels, and in the early stages of the disease, the scan can demonstrate an avascular focus. Lee M. et al. reported 97% sensitivity of high-resolution triple-head SPECT scans [23].

Radionuclide imaging can be used for early diagnosis of ANFH. Collier BD reported 55% sensitivity using planar radionuclide imaging for aseptic necrosis [36]. Bone scintigraphy equipped with a micro-hole collimator has higher sensitivity for diagnosis of ANFH than bone scintigraphy using a high-resolution parallel-hole collimator. Planar bone scintigraphy using quantitative bone scanning provides physiological data that cannot be obtained using other methods, including MRI [29].

Computed tomography is better at detecting stage II and higher disease compared to MRI and radiography. CT scanning diagnoses subchondral or spongy fractures and collapse, especially when using multiplanar reconstruction. This method of examination allows detection of intraosseous edema, synovitis of the hip joint, heterogeneous signal from the femoral head [51].

The results of laboratory diagnostic methods may indicate a violation of capillary blood flow, increased intraosseous pressure , hypercoagulation syndrome, and a violation of the autonomic nervous system.

physical regulation. Li C. et al. indicate significant deviations in the concentration of coagulation factors in blood plasma when comparing the parameters of patients with non-traumatic ANFH and healthy volunteers. Thus, in patients with ANFH, a significant decrease in the level of ghrelin, an increase in the levels of von Willebrand factor, plasminogen activator inhibitor-1 (PAI-1), C-reactive protein were determined in comparison with the control group, which indicates the involvement of these factors in the pathogenesis of the disease [25].

Zheng L. et al. propose the determination of the level of interleukin-33 in the blood plasma as a diagnostic marker for the development of ANFH. In a study of 125 patients with ANFH, a significant increase in the level of interleukin-33 (174.33 pg/ml) was recorded compared to healthy individuals (90.5 pg/ml), regardless of the cause of osteonecrosis [55]. For the early diagnosis of ANFH, complex biomarkers have been proposed: levels of OPG, RANKL, cross-linked N-terminal telopeptide (NTX), C-terminal peptide of procollagen I (PICP), tumor necrosis factor α and interleukin-1 β 1 for enzyme immunoassay [19].

Excessive bone resorption in the lesion is the main pathogenetic link in the development of aseptic necrosis of the femoral head. Bone resorption is caused by the function of osteoclasts, and the degree of its increase can be determined by examining the levels of bone tissue metabolites.

C-telopeptides are cleaved at the very beginning of collagen degradation, so collagen metabolites do not affect the concentration of C-telopeptides. Measuring β -Cross Laps in blood serum or urine allows us to estimate the rate of degradation of relatively old bone, and α -Cross Laps - the rate of newly formed bone. There is a need to study biochemical indices of bone resorption: deoxypyridonoline (DPID) and pyridinoline in urine, Cross-Laps in blood is a term used to designate 8 amino acids that are components of bone collagen.

Thus, with ANFH, the level of DPID, pyridinoline and Cross-Laps increases several times. However, the indicators of bone resorption markers also change in other diseases, such as osteoporosis,
rheumatoid arthritis , hyperthyroidism, metabolic diseases of the skeleton [6].

Treatment of patients with aseptic necrosis of the femoral head is a complex task due to the delay in diagnosis of the early stages of the disease, and as a result, the only treatment option is often radical surgery – hip replacement. It is known that the long-term and prospective results of hip replacement in young patients are worse than
in older patients. The wide possibilities of performing hip replacement surgery within the framework of high-tech medical care in the last decade, the lack of targeted
Analysis of the results of arthroplasty in medical and preventive institutions and the lack of awareness of doctors about other possible treatment methods leads to the choice of traumatologists-orthopedists in favor of hip joint endoprosthetics even in the early stages of the disease [5]. Thus, in the USA, out of more than 500 thousand total hip joint endoprosthetics operations per year, 5–18% are performed for osteonecrosis of the femoral head [13, 47]. In Russia, according to the data of the hip joint endoprosthetics registry of the R. R. Vreden Russian Research Institute of Traumatology and Orthopedics of the Ministry of Health of the Russian Federation (St. Petersburg), from 7.0 to 14.8% of arthroplasty operations per year are performed for ANFH [5].

The goal of pharmacological therapy in the early stages of ANFH is to reduce the intensity of bone resorption of the femoral head, stimulate osteoregeneration, which leads to an increase in bone mass, improves its quality, increases strength and prevents the development of impression deformity [4].

In clinical studies, bisphosphonates have been shown to enhance osteoclast apoptosis and prevent femoral head collapse.

Active metabolites of vitamin D3 and calcium preparations affect the proliferation of osteoblast precursors, activate bone formation processes and improve the mineralization of newly formed bone tissue. Improved calcium absorption in the intestines contributes to an increase in skeletal mass and increases the mineral composition of bone, including its cortical component, which determines the strength properties of the femoral head [8].

Correctors of bone and cartilage tissue metabolism, such as ossein-hydroxyapatite complex, are not only a substrate for the formation of new bone tissue, but also a fairly effective stimulator of bone formation, compensating for hypophosphatemia, the development of which is possible with the use of bisphosphonates [4].

Since it is known that among the etiological factors of ANFH, pathology of the blood coagulation system plays a certain role, the use of anticoagulants is suggested in the treatment of the disease [25].

In case of severe pain syndrome, nonsteroidal anti-inflammatory drugs (NSAIDs) are used in combination with centrally acting muscle relaxants [4]. Disaggregants are prescribed to improve microcirculation in the affected area [22].

A promising area of development is stimulation of bone regeneration by transplantation of osteogenic or angiogenic progenitor cells in combination with auxiliary growth factors. An experimental model of transplantation of mesenchymal stem cells transgenic for hepatocyte growth factor in post-traumatic ANFH has been developed [49].

Total hip arthroplasty does not always provide optimal results for young patients. In recent years, the following organ-preserving surgeries in the early stages of ANFH have been increasingly discussed: central decompression, percutaneous drilling, vascular and avascular bone grafting, corrective osteotomy [24, 47].

A promising developing technique is debridement of necrotic bone tissue of the femoral head using avascular and vascular bone transplantation with subsequent restoration of the viability of the head and prevention of collapse of the articular surface. The avascular technique is used in the state

precollapse and minimal postcollapse with relatively preserved articular cartilage. In the postoperative period, 85% of patients were

It is necessary to relieve symptoms with minimal progression of osteoarthritis. The graft used is mainly the patient's own fibula [47].

Vascularized bone transplantation provides prognostically better results and allows for the restoration of the subchondral surface at later stages of the disease. Surgery

is performed using microvascular technology. Most often, a vascularized section of the fibula is used for transplantation.

Mishra PK et al. obtained positive results with bone grafting on the triple muscular stem using the sartorius muscle, the fascia lata muscle and part of the gluteus medius muscle [32].

Unlike various types of osteotomies of the proximal femur, the decompression method does not cause postoperative bone deformation, but, on the contrary, is aimed at restoring the anatomy of the bone -

and even in the case of an unsatisfactory result, the femoral head impression does not occur and does not subsequently lead to technical difficulties when performing hip arthroplasty [5]. Currently, various modifications of the classical decompression of the focus of osteonecrosis of the femoral head have been proposed [27, 34].

In young patients, axial decompression has proven itself to be a widely used procedure in the treatment of ANFH. The goal of the intervention is to reduce intraosseous pressure and, as a result, improve the blood supply to the femoral head. Mont MA et al. demonstrate a significant interval of hip joint survival after performing decompression of the femoral head in the range from 33 to 95% [34]. At the same time, some authors believe that decompression of the osteonecrosis focus have a positive effect on the effectiveness of treatment [50]. Others note that axial decompression in osteonecrosis does not affect the outcome at all.

progression of the disease, but only eliminates clinical symptoms [26]. It is noted that the method of axial decompression with replacement of bone tissue with synthetic materials (calcium sulfate and calcium phosphate) is more effective [52]. The requirement for a biocomposite material is not only its mechanical strength, which allows preventing the collapse of the femoral head, but also high inductive capabilities for bone tissue remodeling throughout the entire treatment period [45]. At the same time, in the studies conducted by researchers

of the femoral head

ANFH versus axial decompression. Improved vascular proliferation, increased blood flow, and osteogenic differentiation of bone marrow stromal cells were observed, and higher expression of vascular endothelial growth factor (VEGF) and BMP2 was detected when using negative pressure versus internal decompression [54].

Bone marrow mesenchymal stem cell transplantation has been studied and, according to a meta-analysis, this technique has demonstrated better therapeutic efficacy compared to

with axial decompression [26]. According to Q. Mao et al., when introducing 100–200 ml of one’s own bone marrow mononuclear cells enriched with 30–60 ml of mesenchymal stem cells into the medial circumflex artery of the femur with subsequent intra-arterial perfusion into the femoral head, a statistically significant 92.3%

significant clinical results within 5 years after the procedure [30].

Combined techniques such as mesenchymal stromal cell transplantation supplemented by vascularized bone grafting have also proven successful [9]. Less effective has been the combination of axial decompression with injections of autologous bone marrow taken from the iliac crest [16]. However, in most cases, it is not possible to prevent disease progression, and the main

Total hip replacement remains the treatment method , especially in the late stages of osteonecrosis with an impression fracture of the femoral head [46]. However, subsequent generalization of research results will probably help to develop an algorithm for the diagnosis and treatment of ANFH, which will allow delaying, and in some cases, completely preventing hip replacement.

Currently, numerous instrumental research methods have been developed and implemented in healthcare practice for diagnosing patients with ANFH. One of the main research methods is the X-ray method, which allows for the identification and analysis of structural changes in bone tissue, as well as for diagnosing the disease and the outcome of treatment [26, 79, 169].

In the past, several staging classifications have been introduced and used, some based on plain radiographs alone and others based on imaging techniques such as computed tomography, magnetic resonance imaging (MRI), or bone scintigraphy.

It has been demonstrated that early diagnosis of AVN plays a crucial role in terms of prognosis and therapeutic success [18, 44, 116]. The classification system introduced by Ficat [20, 53, 120] is probably the most frequently used. However, this classification system has been criticized in the literature due to the large variability both between and within observers [26, 79 , 169]. Moreover, the Ficat classification does not take into account the size and location of the necrotic area. To properly account for the missing parameters, the ARCO (Association Research Circulation Osseous) classification system has been introduced [29, 85, 132].

The Ficat and Arlet classification uses a combination of plain radiographs, MRI, and clinical features to stage avascular necrosis of the femoral head. Classification Stage 0 Plain radiograph: normal MRI: normal Clinical features: none Stage I Plain radiograph: normal or mild osteopenia MRI: edema Bone scan: increased uptake Clinical features: pain usually in the groin Stage II Plain radiograph: mixed osteopenia and/or sclerosis and/or subchondral cysts, without subchondral opacity (crescent sign: see below) MRI: geographic defect Bone scan:

increased uptake Clinical features: pain and stiffness Stage III Plain radiograph: crescent sign and possible cortical collapse MRI shows subchondral necrosis of the femoral head with elements of bone tissue resorption and elements of cystic remodeling of the lesion.

In their X-ray studies, Martyn J., Parker et al., 2004; Rodriguez JA et al., 2006 obtained the severity of trophic disorders, significant disruption of the articular ends, especially when patients have residual local and diffuse osteoporosis, often exceeding that in congenital dysplasia, as well as residual signs of previous bone destruction of the hip joint [29, 85, 132].

The disadvantages of the method are that in the early stages of the disease, when there are minor changes in the fibrous and hyaluronic cartilage of the hip joint, it cannot visualize the cartilaginous structures of the joint, paraarticular soft tissues, and intra-articular fluid accumulation [36, 125, 179].

X-ray examinations are supplemented by MRI, CT, and MSCT, which help to clarify minor changes in the hip joint and surrounding soft tissues [195, 213, 226].

According to Ermakov E.A. et al. (2002), the use of modern diagnostic methods by duplex scanning of the vessels of the hip joint area in ANFH disease allows predicting the degree of risk of developing aseptic necrosis in the heads of the femur [37, 41, 86] .

Researcher Shorin I.S. (2018) characterizes that magnetic resonance imaging allows identifying and localizing changes in the so-called soft tissue structures of the hip joint area and makes it possible to identify the pathological condition that has arisen in the femoral head [51, 115, 165].

However, these studies do not provide complete information about the early and precise localization of the lesion, its form and extent, and also do not allow us to isolate and analyze all areas of bone tissue.

Radiography should be carried out in three projections of the hip joint (HJ) and the characteristic feature of this study is the "eggshell" symptom on the axial projection of the joint in the initial stages of aseptic necrosis of the femoral head [52, 114, 160] . In this case, the presence of widening of the joint space is noted, as well as a slight decrease in the height of the epiphysis on the anteroposterior radiograph and characteristic zones of enlightenment of the subchondral bone of the right femoral head are observed on the axial projection of the HJ - on the basis of the above, a correct diagnosis can be made [56, 129, 136] .

Currently, ultrasound with Dopplerography helps to clarify the diagnosis and select surgical treatment tactics. This technique makes it possible to evaluate the blood circulation of the lower extremities and determine the blood flow velocity [140, 171, 228].

Thus, ultrasonography with Dopplerography provides the opportunity to examine vessels and diagnose the level of vascular disorders, allows for blood flow assessment and differentiation of the stages of the pathological process in the hip joint [144, 158, 199].

The most popular diagnostic method is densitometry, which allows us to determine the complete picture of the state of the IPC and makes it possible to determine the tactics of surgical treatment [146, 153, 189].

Early diagnostics of ANFH is a difficult task to determine the stages of the disease. MRI allows to detect pathological changes in bone structures and para-articular tissues at early stages of the disease. This method reduces the diagnostic period and determines the timely initiation of treatment [147, 174, 251].

Yu. L. Venevtseva, A. Kh. Melnikov, T. A. Gomova, 2012, conducted skeletal BMD using dual-energy X-ray absorptiometry (DXA) methods; according to its data, a decrease in BMD in patients with ANFH is prevalent.

Today, the classification of aseptic necrosis of the femoral head AKRO is very often used in the practice of orthopedic traumatologists , which includes changes in the femoral head, such as head collapse, bone marrow edema, synovitis and localization of the lesion . Taking into account the anamnestic data of the disease, the entire complex of laboratory and instrumental data, it allows to objectify the diagnosis, differentiate treatment tactics, and monitor the results of therapy at early and late stages of observation [62, 63, 64, 65, 67]

§ 1.3. Surgical treatment of patients with aseptic necrosis of the femoral head

Many authors have recommended symptom-based treatment together with the Ficat and ARCO classification using radiographs and MRI. Treatment with pulsed electromagnetic fields or core decompression or both, bone grafting and decompression, and rotational percutaneous osteotomy have been suggested for Ficat stage I lesions [61 , 168 , 181 , 188]. These procedures as well as vascularized fibular bone grafting, rotational pertrochanteric osteotomy, and intertrochanteric osteotomy are recommended for stages II A and B [200 , 211] . All of these treatments as well as resurfacing and total hip replacement are recommended for stage III lesions. The choice of treatment and the assessment of its efficacy often directly depend on the Ficat/ARCO stage. Thus, the definition of the Ficat or ARCO stage has important implications since it directly relates to the clinical course of the patient.

The results of conservative treatment depend on the age and general condition of the patient and, above all, on the stage, localization, and severity of the process. Conservative treatment includes pain relief; patients take analgesics and anti-inflammatory drugs [61, 168] .

According to Nasonov E.L. 2002, the frequency of ANFH in patients taking corticosteroids is from 3 up to 20%. Also, the authors used skin traction for a long period to unload the hip joint in aseptic necrosis of the femoral head. However , this method is not widespread due to the limitation of active movement of patients due to their prolonged stay in bed, as well as the minimal load in the area of the femoral head, which worsens the quality of life [181, 188].

Currently, existing conservative methods of treatment of patients with early stage ANFH which often do not lead to the desired results. There are no safe methods of pain control and highly effective treatment methods . In patients with ANFH in the early stages, intra-articular administration of hyaluronic acid preparations is used , which reduces pain and improves joint function [200, 211].

A modern method of treatment at present, the use of platelet-rich plasma (PRP) which is very promising. PRP contains alpha granules of platelets with growth factor, which gradually enter the surrounding tissue, thereby improving the regeneration or reparative process of the impact on inflammation, stimulation of local immunity and increase in local blood supply. The obtained data on the implementation of PRP are ambiguous in their judgment depending on the results and the stage of the disease [206, 210].

Using platelet-rich plasma in the early stages of ANFH, we obtained very good results in 88.9% of patients. The duration of remission increased for at least 6 months [237].

Thus, the use of ORP is a modern, effective and promising conservative treatment method. According to Ito H . et al ., 1999; Nishii T ., 2002; Hernigou P. , 2004] when using conservative treatment in patients with ANFH, good results were obtained when a small segment was involved in the pathological process, but also more than 2/3 of the supporting surface of the femoral head [227].

When considering the problem of pharmacological effects on ANFH, a number of questions arise that require resolution [217, 234].

Recently, a modern new innovative method has been used for severe pain syndrome against the background of ANFH before the denervation stage (ablation). The method of radiofrequency neuroablation (RFA) is used to reduce pain in the hip joint also when it is impossible to replace the joint. Ablation (denervation of sensory nerves) is a new, simpler and more effective method of treatment. RF denervation of sensory nerves of the hip joint - at The most widely used method is RF ablation (RFA) of the obturator and femoral nerves in aseptic necrosis of the femoral head, without surgery [231].

In case of severe and extensive destructive lesions of the femoral head, the pain is permanent. Then the patient inevitably undergoes joint replacement surgery . The method we propose is an innovative method of joint pain relief, which consists of "switching off" the pain nerve endings that envelop the joint: radiofrequency denervation (ablation). Radiofrequency denervation of the hip joint is performed in case of intense pain syndrome, even when other procedures - injections of hyaluronic acid, hormonal drugs and even knee surgery have been unsuccessful [222; 1089-1095-p.]. Sensitive innervation of the hip joint is carried out by means of the articular branches of the obturator, femoral and superior gluteal (coming from the sciatic) nerves. The main symptoms associated with hip pain are located in the groin, femoral and trochanteric areas. Inguinal and femoral pain arise from the sensory branches of the obturator nerve, while trochanteric pain arises from the sensory branches of the femoral nerve [215].

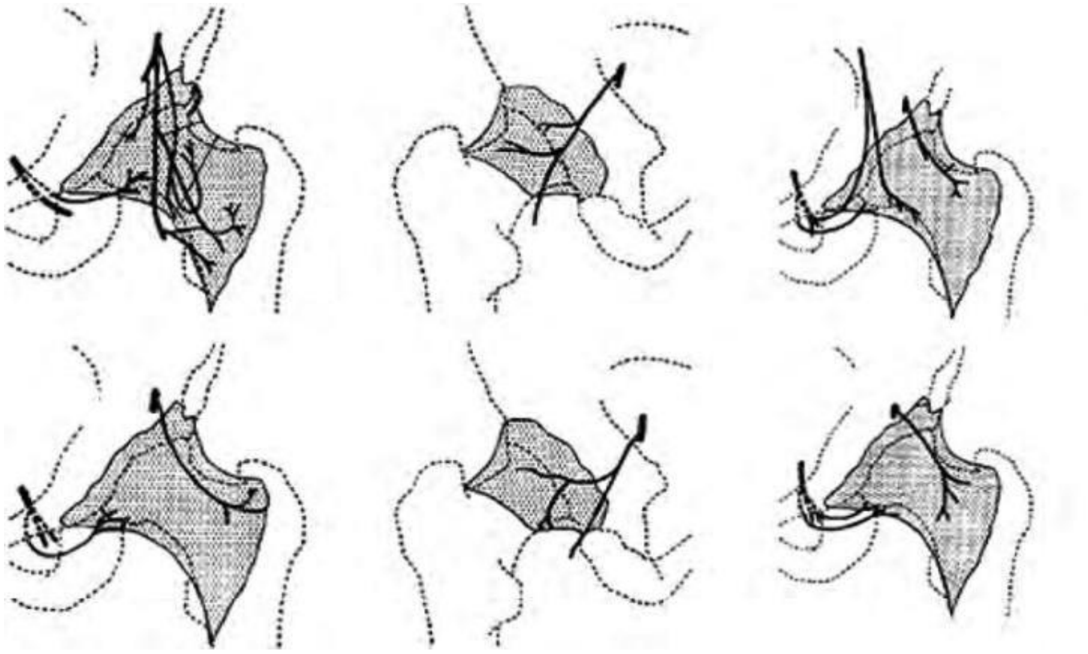


Figure 1.1 Innervation of the hip joint according to S. Locher

Subsequently, a large number of different methods and approaches for surgical denervation of the hip joint were proposed, however, due to the complexity of the procedure, ambiguous results and residual problems associated with iatrogenic nerve damage, all of these methods were abandoned over time [193].

In order to treat coxalgia S. Heywang – Robrunner with CT control performed blockade of the obturator nerve with a large volume of 1% lidocaine solution in 15 patients with osteoarthritis of the hip joint. Four patients noted sufficient regression of pain syndrome for a period of 3-11 months, another 3 patients - for a period of up to 8 weeks. A short-term effect or no effect was noted by 4 patients, for 1 day - 2 patients, no effect - 2 patients. There were 18 patients in the group. The authors administered a local anesthetic to one group, and a saline solution to the control group . Five patients in the main group noted a decrease in pain syndrome, 8 - an increase in the range of motion. However, after 4 weeks there was no reliable difference between the patients of both groups [216].

Important and relevant questions for obtaining maximum efficiency from the procedure, as well as its safe implementation and avoidance of adverse effects are [249]:

- an accurate understanding of the innervation of the hip joint;
- variable topographic anatomy of nerves;
- location of large vessels;
- secondary damage to small vessels that supply blood to the joint;
- changes in the joint caused by disruption of its innervation and vascularization.

Most anatomical works do not provide the necessary information about the trajectory of the nerves in relation to the bone structures, which is necessary for the development of a reliable and easy reproducible procedure. It is also necessary to understand the optimal volume of denervation, whether radiofrequency neuroablation of one nerve is sufficient or whether there is a need for coagulation of several nerves. Basic anatomical data on the innervation of the hip joint can be used to guide the radiofrequency neuroablation procedure, although with significant variations [223].

The use of RFNA is a modern, effective and promising method of treating patients with aseptic necrosis of the femoral head ; patients report pain, from minor in stages 1-2 of the disease to unbearable and severe in the third stage [232].

Thus, the detection of ANFH at early stages and its surgical treatment using the proposed method allows in most cases to prevent the development of pathology and achieve good clinical results [1, 2].

In addition, existing methods of treating patients with coxarthrosis do not always lead to the desired results. In coxarthrosis, the use of platelet-rich plasma

(PRP) is very promising. PRP improves the reparative process, provides the maximum effect of reducing inflammation, stimulates local immunity and increases local blood supply [5.].

Late detection of ANFH and, as a consequence, late initiation of treatment worsens the prognosis. The natural course of osteonecrosis is directly related to the size and location. Small lesions (less than 15% of the femoral head)

bones) can fully recover with treatment. Conversely, lesions that involve more than 50% of the femoral head are highly likely to progress to collapse and ultimately require total joint replacement [92] .

Particularly important is the patient's failure to comply with the orthopedic regimen, the presence of concomitant pathology and chronic diseases. For example, in patients with concomitant osteoporosis, treatment continues for a longer period, which should be taken into account when determining the patient management tactics. The existing risk of cardiovascular or gastrointestinal pathology in patients with AN should be taken into account when choosing drugs [92] .

Conclusion to the chapter:

The treatment of aseptic osteonecrosis of the femoral head has been the subject of numerous therapeutic and surgical proposals due to the lack of a medical treatment with proven efficacy. For many years, the goal of surgical treatment was to avoid total hip arthroplasty with uncertain survival in patients considered too young (30-50 years) for this procedure. Thus, numerous conservative treatments have been proposed: primary decompression with numerous variants, non-vascularized and vascularized bone grafts, intertrochanteric and rotational transtrotomy, cementation. The lack of a unified classification and ignorance of the natural history have long made it difficult to interpret the results. However, these treatments have proven to be effective only in the very early stages and among them in limited osteonecrosis , medial rather than central and especially lateral, with discrepancies in etiology, with the exception of sickle cell anemia, recognized as pejorative.

The most recent advances are primary decompression using stem cells and advances in total joint arthroplasty, the reliability of which has allowed indications to be expanded to younger patients. Most other interventions have disappeared or nearly disappeared because of their lack of effectiveness, especially in major and complex surgeries, sometimes due to long rehabilitation, and because they complicate joint replacement. This argues for early detection of osteonecrosis at an early stage.

Thus, the analysis of literary data on ANFH shows that there is a sufficient number of works on the study of etiopathogenesis, clinical picture, complex treatment with ANFH at the present time, modern methods of complex treatment and rehabilitation measures with deep analysis do not solve all the problems of restoring the functions of the hip joint. Taking into account the above, conducting scientific research in this direction on the study of ANFH still remains relevant .

When conducting complex treatment in patients with ANFH, despite the positive aspects , the problem of constant pain before and after surgery and a high risk of complications remains.

There are no long-term functional results in the literature on endoprosthetics depending on types of endoprosthesis, and issues regarding the rehabilitation of patients with this disease have not been resolved.

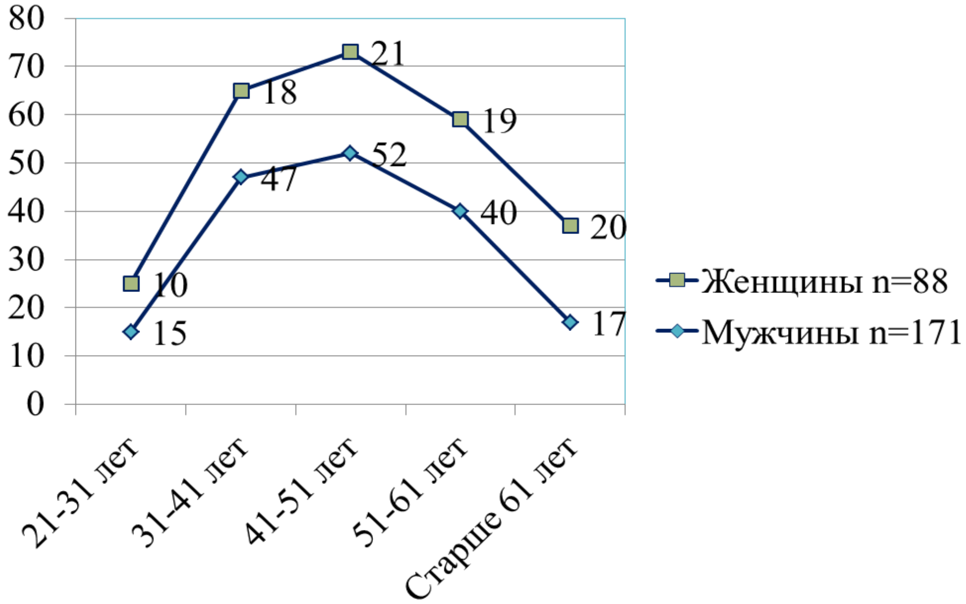
CHAPTER 2. MATERIALS AND RESEARCH METHODS

§ 2.1 General characteristics of clinical observations

We observed 259 patients with ANFH: stage I - 22 (8%) patients, stage II - 83 (32%) patients, stage III - 84 (33%) patients, stage IV - 70 (27%) patients. Of these, 88 (35%) were women, 171 (65%) were men. The patients were inpatients in the Department of Orthopedics and Trauma Consequences of the Bukhara Regional

Multidisciplinary Center, a private clinic in Bukhara “ StarOrthomed ” , from 2015 to 2021 .

The patients were divided into the main (n= 172) and control groups (n=87). The main group included patients who had undergone complex conservative treatment and surgery using our proposed method, and the control group consisted of patients who had also undergone complex conservative and surgical treatment using traditional methods.



The average age of men is 34.2±7.4, of women 29.33±2.2

Figure 2.1 Distribution of patients by age.

Among our patients, patients aged 41 and older predominated. Osteonecrosis of the femoral head occurs predominantly in middle-aged and older patients. Among our patients, men predominated – 171 (65%).

Table 2.1.

Patients depending on age and stage of the disease.

Stages Diseases	Age of patients					Total	M	Z
	Up to 25	26-35 year	36-45 year	46-55 year	Over 56 year			

		years old	s old	s old	s old	s old			
Stage I	Main	1	1	2	4	6	14	M 3.5±2.8	p>0.1
	Control	1	1	1	2	3	8	M 2± 1,3	
Stage II	Main	2	4	12	16	28	62	M 15.5 ± 5	p>0.1
	Control	1	2	5	6	7	21	M 5.25 ± 3.25	
Stage III	Main	5	5	7	14	21	52	M 13±6.25	p>0.1
	Control	1	2	4	11	14	32	M 8 ± 6.5	
Stage IV	Main	3	4	7	12	18	44	M 11 ± 10.5	p >0.1
	Control	1	3	4	7	11	26	M 6.5 ± 5.3	
Total	Main	11	14	28	46	73	163	M 43 ± 22	p>0.1
	Control	4	8	14	26	35	96	M 21.8 ± 15.5	

From Table 2.1 it is evident that the patients were mainly in stage III - IV 154 (60%) and of working age 151 (59%). These indicators indicate the urgency of the need to treat such patients.

We analyzed the time of patients' visits to doctors after the appearance of the first signs of ANFH, which are presented in Table 2.2.

Table 2.2.

Patients' appeals from the onset of the disease ANFH.

Stages		Periods				Total
		Up to 1 year	Up to 5 years old	Up to 10 years	Later 10 years	
Stage I	Main	1	11	2	0	14
	Control	2	5	1	0	8
Stage II	Main	23	21	15	3	62

	Control	13	4	4	0	21	
II stage	Main	25	15	12	0	52	
	Control	26	5	1	0	32	
Stage IV	Main	42	2	0	0	44	
	Control	21	5	0	0	26	
Total	Main	91 (52%)	49 (27%)	29 (17%)	3 (4%)	163	259
	Control	62 (71%)	19 (22%)	6 (7%)	0	96	

As can be seen from Table 2.2, most patients sought medical attention onset up to one year of the onset of the first symptoms of the disease. Some patients were treated by a traumatologist or other doctors.

Before admission to our hospital, 182 (70.2%) were treated conservatively. They received standard treatment with NSAIDs, drugs that improve tissue microcirculation (pentoxifylline), anti-edematous (l-lysinates) drugs, physiotherapy, exercise therapy, intra-articular injections (hyaluronic acid) in the hip joint area in outpatient settings or other hospitals (Table 2.3).

Table 2.3.

Distribution of patients with ANFH before admission to hospital.

Stages of the disease		Were treated	Didn't get treatment	Total
Stage I	Main	1	13	14
	Control	0	8	8
II stage	Main	32	30	62
	Control	10	11	21
II I stage	Main	45	7	52
	Control	29	3	32
Stage IV	Main	42	2	44
	Control	23	3	26

Total	Main	120 (69.7%)	52 (30.3%)	172	259
	Control	62 (71%)	25 (29%)	87	

The table shows that conservative treatment was performed in 182 (70.2%) patients out of 259, the majority of which were at stages III - IV of the disease. If long-term conservative treatment was ineffective, patients with stages III - IV underwent hip arthroplasty. Upon admission of patients, clinical examinations began with collecting complaints, a detailed history of the disease, an objective examination of the general and local condition, as well as past diseases. All patients had pain in the hip joint area, limited or, in some patients, no movement in the joint, shortening of the limb, a gradual increase in chromatism of the lower limb, and hip joint contractures were also observed. Most patients noted non-simultaneous joint damage. All patients with ANFH were studied using the computer program we developed (patent No. DGU 06726 dated 06/12/2019), which took into account the intensity of pain, joint mobility, and the ability to walk.

§ 2.2. Clinical characteristics of patients with aseptic necrosis of the femoral head .

Clinically, patients with osteonecrosis of the femoral head were divided into 4 stages.

Computer program DGU No. 06726.
Survey map.
patients with injuries and diseases of the hip joint.
1.Full name.____No. and/b _____________
2.Year of birth (age in years)_______________________________________
3.Home address____
4. Telephone: home______________office________________________
5. Methods and duration of treatment:
a) Before admission to the clinic
6) Diagnosis on admission
7. Diagnosis at discharge____
8. Date of receipt:____
9. Date of issue:____
10. Bed day : before surgery______________after surgery________________

11.Type of deformation____
12. Date and type of operation in the clinic (brief description)____
13. Type of anesthesia____
14. Blood transfusion (quantity)________________________________
15. Postoperative treatment:
a) Medicinal____
b) Physiotherapy____
c) exercise therapy, massage
d) Partial load period______________________________________
e) full load period____
16. Examination upon admission to hospital in the late stages after treatment:

No.	Operated joint	Unoperated joint
1. Functional characteristics		
- No pain – 5 (can walk more than 1 km)		
- Pain is moderate after walking, goes away after rest – 3 (can walk from 100 m to 1 km)		
- Severe pain – 1 (cannot walk)		
2. Gait		
- Normal - 5		
- Impaired (walks with the help of a stick) – 3		
- Severely impaired (walks with crutches) – 1		
3. Posture		
- Normal - 5		
- Lordosis with pelvic rotation up to 40^{0} – 3		
- Lordosis with pelvic rotation over 40^{0} – 1		
4. Puts on stockings and shoes		
- On your own – 5		
- With difficulty - 3		
- Impossible - 1		
5. Can walk up and down stairs		
- On your own – 5		
- With difficulty - 3		
- Impossible - 1		
6. Atrophy		
- No – 5		
- Less than 3 cm – 3		

- Exceeds 3 cm – 1

7. Shortening
- Missing – 5
- Up to 2 cm – 3
- Over 2 cm – 1

8. Pulsation (a . dorsalis pedis)
- Distinct – 5
- Comparatively less distinct – 3

9. Sensitivity of the limb
- Not broken - 5
- Hypoesthesia – 3
- Hyperesthesia – 1

10. Mobility in the hip joint
- Bending to an angle of 60-70 ^{0} – 5
- Less than 130 ^{0} but more than 50 ^{0} – 3
- Less than 50 ^{0} – 1

11. Extension
- 180 ^{0} – 5
- Limited to 35 ^{0} – 3
- Limited to more than 35 ^{0} – 1

12. Abduction to the hip joint
- Up to 45 ^{0} – 5
- From 44 ^{0} to 25 ^{0} – 3
- Less than 24 ^{0} – 1

13. Abduction to the hip joint
- Up to 60 ^{0} – 5
- From 59 ^{0} to 30 ^{0} – 3
- Less than 29 ^{0} – 1

14. Bringing to TBS
- Up to 30 ^{0} – 5
- From 25 ^{0} to 10 ^{0} – 3
- Less than 9 ^{0} – 1

15. Rotation in TBS
- 90 ^{0} (45 ^{0} each) and internal)– 5
- From 89 ^{0} to 45 ^{0} – 3
- Less than 45 ^{0} – 1

17. Radiographic signs:

1. The hip joint is restored
- Good - 5
- Satisfactory - 3
- Unsatisfactory - 1

18. MRI of the hip joint (brief description)____
19. Densitometry (brief description)____
20. Social indicators:
No. Before surgery After surgery 1. Working capacity - Full - 5 - Limited sedentary work – 3 - Disability - 1 2. Profession: - Remained the same - 5 - Changed - 3 - Not working – 1 3. Period of incapacity for work (disability) - - -
21. Complications during treatment and their causes________________________________
22. Overall assessment according to the scheme____

The main clinical signs in all patients with ANFH are joint pain, which intensifies at night. Pain in the groin area radiating along the anterior surface of the thigh during physical exertion is observed in the gluteal region and knee joint. During an objective examination of patients, smoothing of the contours of the hip joint is noted and pain is determined during palpation. During rotational movements, flexion, abduction and adduction in the joint, patients feel increased pain.

Thus, we noted that clinical signs such as pain gradually increase over the years, mobility and limitation of movement in the hip joint in ANFH depend on the stage of the disease.

§ 2.3 X-ray examination

In ANFH, X-ray data is of great importance, based on these data, it is possible to determine the stages of the disease. X-ray data in ANFH has 4 stages and coincides with the clinical picture. Based on X-ray data, we can identify degenerative - dystrophic changes in the hip joint in ANFH and choose a treatment method.

We studied radiographic data in 259 patients with ANHB from 2015 to 2021, who were in the Department of Trauma Consequences and Orthopedics of the Bukhara Regional Multidisciplinary Medical Center and the private clinic " StarOrthomed " in Bukhara . All patients underwent X-ray examinations before and after treatment in the area of the hip joints in direct projection. Using X-ray examination, we clarified the stages of the disease, the degree of damage to the femoral head, as well as to study the prevalence of the necrotic process and the articular surface and joint space.

§ 2.4. Dopplerographic examination

Dopplerographic studies are one of the methods in modern functional diagnostics of ANFH. With the help of ultrasound Dopplerographic study the state of the vessels is increasingly determined. This method is distinguished by its relatively low cost, simplicity, dynamism, and safety of research, which determines a wide range of ultrasound characteristics of the area being studied. Research is carried out using the Mindray ultrasound scanner. DC - 7 (China), which enables high-quality examination of blood vessels and allows more accurate diagnosis of the level of vascular disorders in the area under study. The main parameters for assessing the obtained Dopplerograms are the following: peak systolic velocity (PSV), resistance index (RI) and pulsation index (PI). The values of these parameters make it possible to determine the quantitative characteristics of blood flow in the vessels under study. This research method makes it possible to determine vascular constriction using these peak systolic velocity deviations. The resistance index (RI) and pulsation index (PI) parameters determine the derivative characteristics of Dopplerograms to eliminate errors in quantitative analysis and allow indirectly judging the presence of peripheral vascular resistance. At an early stage of osteonecrosis, bone changes are often not detected on radiography. And with the help of Dopplerography, it is possible to detect disease progression in the area of osteonecrosis in the form of avascularization of the zone, and in the last stage to determine vascular destruction, in which pathological vessels appear. The safety of the method makes it possible to conduct multiple studies and makes it possible to track the results of the treatment. Dopplerographic methods of research were carried out on the common femoral artery (CFA), superficial femoral artery (SFA) and deep femoral artery (DFA) and similar veins of the thigh of the examined patients. For comparison of indicators, Dopplerographic results of 2 2 healthy patients were taken .

We know that the superficial femoral artery (SFA) continues to the level of the Gunter's canal without dividing. In the distal parts of the thigh, then leaving the canal, gives off the descending genicular artery and is called the popliteal artery. From this artery in the distal part, small muscular branches depart. The deep femoral artery (DFA) is directed to the posterolateral region of the thigh and from the mouth of 4 perforating arteries ends in the distal third of the thigh. This artery along the course gives off the external circumflex femoral artery with ascending, transverse and descending branches. When 3 perforating arteries that feed the heads, cups and neck of the femur are affected, ANGFK is noted. Using a linear sensor with a frequency of 5 MHz, the femoral vessels are first visualized. To study the vessels (arteries and veins), Dopplerographic research methods were carried out on 45 patients in the ultrasound Dopplerography room with the help of a specialist in the preoperative period, in the postoperative period after 10 days, and dynamically in the 6-month period after treatment.

Table 2.4

Ultrasound Doppler study of patients with aseptic osteonecrosis in different groups.

Result during treatment	In 6 months	Result during treatment	In 6 months
64.1	72.5	71.2	72.3

62.5	81.2	63.3	65.1
56.9	76.1	55.1	59.7
52.3	84.6	68.3	63.1
69.7	79.2	55.5	59.1
55.8	72.4	56.2	55.2
45.3	86.7	57.3	58.1
67.9	74.3	61.3	72.1
63.4	75.4	66.2	54.2
52.9	76.1	52.5	51.2
58.4	73.4	56.2	54.1
67.8	92.3	68.3	70.4
52.3	88.6	70.3	65.3
56.7	83.1	63.1	62.1
63.7	75.2	57.5	59.7
67.1	74.1	69.3	71.2
63.7	85.9	52.5	55.8
55.1	76.3	63.3	64.1
67.8	77.1	51.3	54.7
59.1	93.4	61.1	63.4
58.1	71.9	69.3	78.1
62.7	70.8	62.3	68.7
67.2	75.5		
M 60.29±69.7	M 78.96±93.4	M 61.43±71.2	M 62.62±78.1
p <0.001	p >0.1	p >0.1	p <0.001

§ 2.5. MRI studies of ANFH

MRI is the optimal method for diagnosing hip joint damage in patients with ANFH. Magnetic resonance imaging (MRI) is a safe and painless method of examination, with the help of which it is possible to obtain a detailed image of various organs and other structures of the body. The advantage of this method is the ability to examine various soft tissues and organs, much more accurately than when using other methods. In some cases, the method makes it possible to evaluate the function of organs, allows to establish the presence of damage in the early stages of the disease. This method allows a high accuracy assessment of the presence of stages of damage to the femoral head.

Under our supervision, all 259 patients underwent MRI examination from 2015 to 2021. Based on the MRI examination, a lesion of the femoral head was detected, which was divided into 4 stages.

§ 2.6 Ultrasound examinations. Indicators of ultrasound densitometric studies in ANFH

The studies were conducted in 76 patients with ANFH, including 22 women (29%) and 54 men (71%). Ultrasound densitometric studies were conducted using the MSLBD 01 sonodensitometer (China) using an ultrasonic linear sensor. The studies were conducted at the level of the calcaneus . The data obtained were interpreted according to the WHO classification by T-criteria and ultrasound transmission velocity (SOS). The studies were conducted at the level of the distal radius. The data obtained were interpreted according to the WHO classification by T-criterion and ultrasound transmission velocity (SOS). According to the recommendations of the WHO expert group on osteoporosis (WHO, 1994), the value of standard deviations of T- and Z-score above -1.0 SD is considered normal, below -1.0 SD is considered a decrease in BMD.

Z - score is the number of standard deviations in the difference between the average score of individuals of the corresponding gender and race.

T - score – standard deviation, which calculates how much The result obtained differs from the average result of a healthy 30-year-old person.

Table 2.5

Results of ultrasound densitometry before and after treatment in the control and main groups.

Main group		Control group	
Result during treatment	In 6 months	Result during treatment	In 6 months
-1.5	-1	-2	-1.8
-1.9	1	-2.5	-2
-2.3	-1.4	-1	-1
-1	2	-1.2	-1.4
-1.6	-1	-1.6	-1.3
-2.6	-2	+1.5	1
-1	1	+1.5	+1.4
M-1±0.05	M-0.38±0.001	M-0.25±-0.25	M-0.4±0.03
p <0.01	p <0.01	p <0.01	p <0.01

§ 2.7. Statistical research methods.

Statistical processing of the obtained data was carried out using the Microsoft Office XP (Microsoft Excel) software package, where the parametric statistics method (M, σ, ± m, t – Student's t-test) was used, and the reliability of the indicators was determined.

Conclusion to the chapter

ANFH is found predominantly in middle-aged and older patients. Among our patients, men predominated – 171 (65%) . Clinical studies began with the collection of complaints, a detailed anamnesis of the disease, an objective examination of the general and local condition, as well as past illnesses. All patients had pain in the hip joint area, limited or, in some patients, no movement in the joint, shortening of the limb, a gradual increase in chromatism of the lower limb, and hip joint contractures were also observed. Most patients noted non-simultaneous, joint damage. In some patients, one patient was observed to have different degrees of clinical signs . Conservative treatment was performed in 182 (70.2%) patients out of 259, of which the majority were at stages III - IV of the disease. In case of ineffectiveness of long-term conservative treatment, patients with stages III - IV underwent hip joint endoprosthetics .

In ANFH, X-ray data is of great importance, based on these data, it is possible to determine the stages of the disease. X-ray data in ANFH has IV stages and coincide with the clinical picture. Based on X-ray data, we can identify degenerative - destructive changes in the hip joint in ANFH and choose a treatment method.

Dopplerography examination enables high-quality examination of blood vessels and allows more accurate diagnosis of the level of vascular disorders in the examined area . Ultrasound Dopplerography with the help of a specialist in the preoperative period, in the postoperative period after 10 days, in dynamics in a 6-month period after surgery.

MRI is the optimal method for diagnosing hip joint damage in patients with ANFH. The advantage of this method is the ability to examine various soft tissues and organs, much more accurately than when using other methods. In some cases, the method makes it possible to evaluate the function of organs, allows you to establish the presence of damage in the early stages of the disease. This method allows you to assess the degree of joint damage with high accuracy.

Ultrasound densitometric studies were carried out using a sonodensitometer. SONOST 3000 (South Korea) by using an ultrasonic linear sensor. The obtained data were interpreted according to the WHO classification by T-criterion and ultrasound transmission speed (SOS).

CHAPTER 3. CLINICAL AND DIAGNOSTIC CHARACTERISTICS OF PATIENTS WITH ASEPTIC NECROSIS OF THE FEMORAL HEAD

§ 3.1 Clinic of patients with osteonecrosis of the femoral head, taking into account the stage of the disease

In patients with ANFH, the severity of the disease is assessed according to the ARCO classification (Association Research Circulation Osseuos 2003). According to this classification, 4 stages of ANFH are differentiated: I, II , III (early), III (late) and IV stages.

The main clinical manifestation of aseptic necrosis is pain. With ANFH, pain in the groin area sometimes radiates along the anterior surface of the thigh to the knee joint. There is also a combination of pain in the hip area with pain in the lower back and gluteal region. Pain in the knee area gives a picture of arthrosis of the knee joint. Most often, the disease manifests itself as a limitation of rotational movement in the hip joint. Then, limitation of abduction joins in, and at the end - a decrease in flexion. In the third and fourth stages, shortening of the limb, curvature of the pelvis, flexion-adduction contracture in the joint, and hypotrophy of the thigh muscles are determined.

We analyzed the clinical manifestations of patients with aseptic necrosis of the femoral head based on stages IV according to ARCO (2003).

Table 3.1

Distribution of patients with ANFH by stages and clinical manifestations.

No.		Stag e I	II stage	III early stage	III late stage	Stage IV
1. Functional characteristics	No pain – 5 (can walk more than 1 km)	14	10	1	0	0

	Pain is moderate after walking, goes away after rest – 3 (can walk from 100 m to 1 km)	26	21	3	0	0
	Severe pain – 1 (cannot walk)	0	3	32	42	35
	Normal - 5	36	25	2	0	0
2. Gait	Impaired (walks with the help of a stick) – 3	0	14	12	19	33
	Severely impaired (walks with crutches) – 1	0	2	17	29	35
3. Posture	Normal - 5	34	28	12	1	0
	Lordosis with pelvic rotation up to 40 ^{0} – 3	0	2	24	22	31
	Lordosis with pelvic rotation over 40 ^{0} – 1	0	3	16	23	26
4. Puts on stockings and shoes	On your own – 5	96	22	3	0	0
	With difficulty - 3	0	0	18	31	42
	Impossible - 1	0	3	22	36	37
5.Can walk up and down stairs	On your own – 5	51	26	11	0	0
	With difficulty - 3	5	15	25	37	42
	Impossible - 1	0	0	25	40	31
6. Atrophy	No – 5	36	23	26	0	0
	Less than 3 cm – 3	0	7	28	42	36
	Exceeds 3 cm – 1	0	0	25	37	38
7. Shortening	Missing – 5	61	45	0	0	0
	Up to 2 cm – 3	0	0	39	34	26
	Over 2 cm – 1	0	0	41	17	21
8. Pulsation (a.dorsalispedi)	Distinct – 5	67	23	16	0	0

	Comparatively less distinct – 3	1	4	13	17	32
9. Sensitivity	Not broken - 5	55	23	21	9	1
	Hypoesthesia – 3	12	10	9	14	11
	Hyperesthesia – 1	13	14	0	0	0
10. Mobility in the hip joint	Bending to an angle of 60-70 ^{0} – 5	62	23	17	0	0
	Less than 130 ^{0} but more than 50 ^{0} – 3	23	22	12	1	2
	Less than 50 ^{0} – 1	0	13	25	27	24
11. Extension	180 ^{0} – 5	65	34	21	0	0
	Limited to 35 ^{0} – 3	0	23	42	12	0
	Limited to more than 35 ^{0} – 1	0	0	25	27	62
12. Abduction with the leg extended	Up to 40 ^{0} – 5	45	31	23	0	0
	From 39 ^{0} to 20 ^{0} – 3	32	21	16	0	0
	Less than 20 ^{0} – 1	0	0	0	45	42
13. Rotation with the leg extended	90 ^{0} (45 $^{0\ each}$ external and internal) – 5	23	21	18	2	1
	From 89 ^{0} to 45 ^{0} – 3	15	16	2	3	1
	Less than 45 ^{0} – 1	0	0	13	24	27
M		20.32±2.5	13.87±1.18	17.24±1.1	15.55±1.18	16.74±1.6

Thus, it was noted that clinical signs such as pain gradually increasing over the years, mobility and limitation of movement in the hip joint in ANFH depend on the stage of the disease. When analyzing the functional signs of the presence of pain and its varying degrees of severity in ANFH in the hip joint by the parameters "no pain with 5 points" and "moderate pain after walking, passing after rest with 3 points" there was a prevalence among patients with stages 1 and 2 of the disease by 14 and 10, as well as 26 and 21 cases. According to the parameter "severe pain with one point" more patients with stages 3 and 4 of the disease were registered by 32, 42 and 35 cases.

According to the parameter of "gait" among patients with stages 1 and 2 of the disease, "normal with 5 points" gait was noted in 36 and 25 cases, and also in patients with stages 3 and 4 of the disease "impaired with 3 points" in 12, 19 and 33 cases, and according to the parameter "sharply impaired with 1 point" was noted in 17, 29 and 35 cases in patients with severe stages of the disease.

According to the parameter "posture", normal posture with 5 points was noted in 34 and 28 cases in patients with stages 1 and 2 of the disease, and in patients with stages 3 and 4 of the disease, posture disorders were noted according to the types "lordosis with pelvic rotation up to 40º with 3 points" in 24, 22 and 31 cases and "lordosis with pelvic rotation over 40º with 1 point" in 16, 23 and 26 cases among patients with stages 3 and 4 of the disease.

The functional ability of patients was assessed by the parameter " puts on stockings and shoes". According to the parameter "puts on stockings and shoes independently with 5 points", prevalence was noted in patients with the 1st and 2nd stages of the disease in 96 and 22 cases, and according to the parameters "with difficulty with 3 points" and "impossible with 1 point", patients with a greater degree were recorded in 18, 31 and 42 cases and in 22, 36 and 37 cases in patients with the 3rd and 4th stages of the disease.

In patients with ANBG, atrophy of the quadriceps muscle of the thigh was noted during examination against the background of long-term dysfunction of the hip joint, the severity of which was also assessed by the parameter "atrophy". According to the parameter "no atrophy with 5 points" among patients with the 1st and 2nd stages of the disease, 36 and 23 cases were registered, and according to the parameters "less than 3 cm with 3 points" and "exceeds 3 cm with 1 point", 28, 42 and 36 cases were noted, and 25, 37 and 38 cases in patients with the 3rd and 4th stages of the disease.

A characteristic manifestation of ANFH is shortening of the damaged limb compared to the healthy limb. The analysis was performed using the parameter "shortening". In patients with stages 1 and 2 of the disease, the prevalence of the number of patients was noted in 61 and 45 cases according to the parameter "no shortening by 5 points", and also according to the parameters "up to 2 cm by 3 points" and "over 2 cm by 1 point" the number of patients was determined in 39, 34 and 26 cases and 41, 17 and 21 cases among patients with stages 3 and 4 of the disease.

One of the characteristic signs of ANFH is the disruption of the rotational functions of the hip joint with the joint extended. According to the parameters "presence of rotation up to 90º and from 89º to 45º by 5 and 3 points" patients in the amount of 23, 21 and 15, 16 cases were noted with the 1st and 2nd stages of the disease, and according to the parameter "less than 45º by 1 point" patients in the amount of 24 and 27 cases were registered among patients with the 3rd and 4th stages of the disease.

ANFH is not only a medical problem, but also a social one with loss of working capacity and their profession. In patients with stages 1 and 2 of the disease, in most cases, working capacity remained completely intact, in 23 and 17 cases it was changed to limited sedentary work, and in stages 3 and 4 of the disease, disability was noted in 14, 26 and 42 cases. Accordingly, leaving the profession was noted in 67 and 32 cases with stages 1 and 2 of the disease, a change of profession in 12, 41 and 32 cases with stages 1, 2 and 3, and in 26, 32 and 42 cases, patients with stages 3 and 4 of the disease do not work.

Upon admission of patients, functional indicators were assessed based on clinical parameters on a 5-point scale; the clinical outcome was assessed based on the analysis of the total score.

Good was in the range of 15 to 22 points, satisfactory - from 8 to 14; unsatisfactory was assessed by a sum of 0 to 7 points.

§ 3.2 Analysis of data from instrumental examination methods of patients with ANFH taking into account the stage of the disease

According to the radiography data, 22 (8%) patients with stage I ANFH disease showed moderate sclerosis (with possible "border") in the affected area on radiographs . At this stage, a weak signal or no signal is typical. This depends on the extent of bone damage. Radiographs are negative in the early stages of the disease. Typically, there is initially mild osteopenia, followed by variable changes such as patchy sclerosis and rim calcification. Gradually, microcracks in the subchondral bone accumulate in dead bone that fails to regenerate, leading to collapse of the articular surface and the crescentic sign of osteonecrosis. Eventually, the cortex is destroyed and fragmented with superimposed secondary degenerative changes. MRI is the most sensitive (~95%) modality and demonstrates changes long before plain radiographic changes are visible. Reactive interface line: focal low-signal serpentine line with fatty center (most common appearance and first sign on MRI) Double line sign: T2WI serpentine peripheral/outer dark (sclerosis) and inner bright (granulation tissue) line are diagnostic (line usually extends to subchondral bone plate, which helps to differentiate it from subchondral fracture) Diffuse edema: edema is not an early sign; on the contrary, studies show that edema occurs in the late stages and is directly related to pain Rim sign: osteochondral fragmentation secondary degenerative change (eg, osteoarthritis) on contrast-enhanced images non-viable bone marrow does not enhance in radiation necrosis edema or fatty replacement of adjacent bone marrow is observed

Figure 3.1 X-ray of patient A.B., born in 1945. No. IB 0338/18 with stage 1 of the disease ANFH

At this stage, we observed widening of the joint space and decrease in the height of the epiphysis on the radiograph, which appears due to the violation of enchondral ossification and noted periarticular osteoporosis, clearly visible in the structure of the bones, also determined their porosity and increased vertical striation. For this stage, minor periarticular osteoporosis was characteristic and deformation of the femoral head is not observed, its shape is not changed, the bone structure is preserved. At this stage of the disease, the radiographic picture is very poor, uninformative. Usually, areas of necrosis of the initial stage are not detected on the radiograph. The absence of radiographic signs of the initial stage of the disease does not exclude the presence of the disease and requires a more in-depth examination. Patients have a clinic of pain, contracture and mild muscle atrophy.

In the second stage, 83 (32%) patients were under our observation. Radiologically, in the second stage, we detected compaction of the epiphysis, a decrease in the height of the epiphysis, an increase in the joint space and a strip of enlightenment.

In these patients, radiological examination reveals: the femoral head is sclerotic, there is a thin strip of enlightenment and a decrease in the height of the epiphysis. A widening of the joint space and a partial reduction of the epiphysis are revealed.

Figure 3.2. X-ray of patient Yu.B., born in 1963. No. IB 6720/546 with stage 2 of the disease ANFH

As can be seen from Figure 3.2, the impression of the upper lateral segment of the femoral head was observed. On the radiograph of the second stage, the femoral head is darkened, the structure is damaged and an aseptic necrosis zone is determined, with the presence of signs of impression. When examining the macropreparation, the femoral head is characteristically wrinkled and has a "lunar surface". At the onset of the disease, the cartilaginous layer is intact, unchanged, without segmental defects. With the development of the disease, as a result of local ruptures of the articular cartilage, exposed affected subchondral bone is observed . MRI examination can detect a necrotic defect in the upper (loaded) section and determines the zone of aseptic destruction with deformation of the articular surface due to the impression of the femoral head. At this stage, a violation of osteosynthesis is observed radiologically and there is an expansion of the joint space, a decrease in the height of the epiphysis is also noted.

We observed 84 (33%) patients with the third stage of the disease. X-ray examination at this stage was characterized by resorption of the necrotic area and the femoral head is noted to be reduced in height and with fragmentation, there is a continuous shadow, and it is also divided into sequestration-like and structureless areas of various configurations.

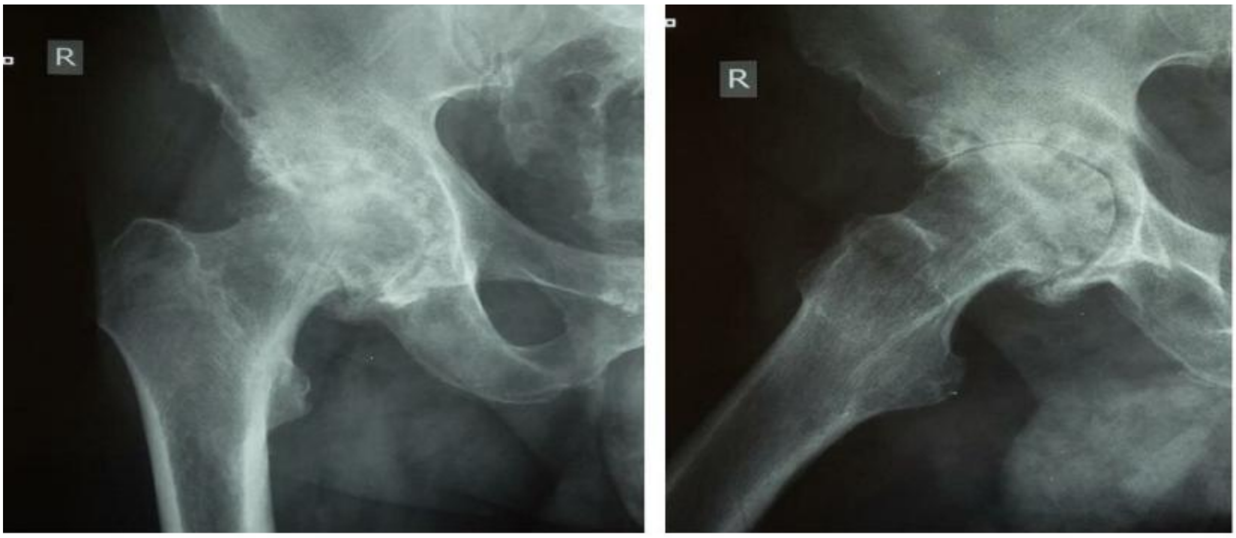


Figure 3.3. X-ray of patient M.A., 1982, No. IB 5185/543, with stage 3 of the disease ANFH.

We have noted that aseptic necrosis of the 3rd (early) stage is initially marked by the head of the femur, the zone of necrosis with "demarcation", also sequestration and has the formation of a saddle-shaped deformation. Multiple foci of aseptic destruction of the head of the femur with signs of impression of bone fragments, violation of the congruence of the articular surfaces. Characteristic of this stage in MRI is the staged development of the process. It developed rapidly (within 12 months) and led to the complete destruction of both the heads of the femur and the joints as a whole. At the third stage of the disease, radiographic signs are characterized by widening of the joint space, the cartilage height decreases.

Figure 3.4. X-ray of patient M.S., born in 1961, No. IB 2992/144, with stage 3 of ANFH disease.

A decrease in the width of the joint space is noted and the height of the epiphysis increases ; normalization of endosteal and enchondral bone formation is observed. In the area of the femoral head, the structural pattern is rough and the direction of the trabeculae is disordered. At this stage, impression of the outer-upper pole of the femoral head, rupture of the Shenton line and a reduced Wiberg angle are characteristic; saddle-shaped deformation is also noted in the area of the head of the left femur.

In stage 4, we observed 70 (27%) patients. These patients had radiological signs of coxarthrosis, with cystic reorganization of the femoral head.

Figure 3.5. Radiograph of patient N.K., born in 1958, No. IB 0347/18, with stage 4 of the disease ANFH.

We have noted that in aseptic necrosis Stage IV is initially noted on radiographs at this stage is traced , but its shape is extremely changed by the type of deforming arthrosis. At this stage, the edge of the acetabulum presses through the contact zone and the so-called "saddle-shaped deformation" is formed. The Wiberg angle becomes negative and secondary arthrosis of the acetabulum is connected, marginal bone growths and dystrophic hands are also noted. In the area, the contact zone of the joint elements increases, while the glenoid cavity does not cover the entire head of the femur and the congruence of the articular surfaces is completely disrupted and patients were observed subluxation of the femoral head. MRI allows you to supplement information about the state of paraarticular tissues and the mutual orientation of the joint elements.

Table 3.2

Distribution of patients with ANFH by stage of the disease .

Stage 1 No changes	Stage 2 diffuse sclerosis, cysts	Stage 3 early subchondral impression deformity of the femoral head	Stage 3 late head collapse, changes in the acetabulum	Stage 4 Outcome, secondary deformation of the femoral head
22 (8%)	83 (32%)	41 (16%)	43 (17%)	70 (27%)

X-ray signs allow the doctor to determine the treatment tactics depending on the course of the disease.

Dopplerography was performed in 45 patients with ANFH to determine the state of blood flow in the main vessels adjacent to the hip joint. The study was conducted in a comparative form with the data of the healthy limb (n = 2 2), and it was determined that the peak systolic velocity (PSV) in the common femoral artery (CFA) was significantly lower ($P < 0.005$) in patients with a healthy limb. Almost the same trend is observed in the study of the superficial femoral artery (SFA). In the deep femoral artery (DFA), the parameters had the opposite trend of change, that is, the PSV indicator is significantly higher ($P < 0.05$) relative to the value of the healthy limb (Table 3.3).

Table 3.3

Comparative indicators of Doppler studies in patients with ANFH.

Groups	P.S.V.	Ri	Pi
Common femoral artery (BOTH)			
Patients (n = 45)	70.5+- 1.5	0.95+- 0.02	6.12 +- 0.03
Healthy (n = 2 2)	76.8+- 1.7	1.15+- 0.02	5.25+- 0.05
Superficial femoral artery (SFA)			

Patients (n = 45)	32.9+- 0.6	1.39+- 0.03	8.9+- 0.1
Healthy (n = 2 2)	51.2+- 1.4	1.19+- 0.02	6.29+- 0.2
Deep femoral artery (DFA)			
Patients (n = 45)	65.9+- 1.9	1.25+- 0.02	1.42+- 0.02
Healthy (n = 2 2)	46.5+- 2.3	1.15+- 0.01	1.19+- 0.02

According to the resistance index (RI) for the OBA, low values were noted relative to the healthy one, in the PBA and GBA, increased values. Data on the pulsation index (PI) showed reliable decreased values in the injured limb relative to the values (P <0.005).

Table 3.4

Resistance index values of both legs in ANFH before and after treatment.

Main group								Control group							
Right leg				Left leg				Right leg				Left leg			
Before treatment	After treatment	In 6 months	In a year	Before treatment	After treatment	In 6 months	In a year	Before treatment	After treatment	In 6 months	In a year	Before treatment	After treatment	In 6 months	In a year
0.66	0.82	0.82	0.82	0.81	0.84	0.89	0.86	0.9	0.92	0.89	0.92	0.92	0.96	0.92	0.98
0.82	0.7	0.69	0.82	0.8	0.78	0.76	0.8	0.86	0.82	0.98	0.8	0.81	0.84	0.89	0.82
0.66	0.82	0.82	0.8	0.81	0.84	0.89	0.82	0.82	0.82	0.72	0.82	0.71	0.84	0.88	0.72
0.82	0.82	0.72	0.82	0.71	0.84	0.88	0.72	0.96	0.82	0.98	0.82	0.9	0.82	0.89	0.96

0.82	0.82	0.82	0.82	0.81	0.82	0.89	0.76	0.96	0.82	0.84	0.94	0.81	0.86	0.89	0.9
0.68	0.82	0.84	0.82	0.81	0.86	0.89	0.9	0.82	0.72	0.92	0.84	0.96	0.84	0.89	0.88
0.82	0.72	0.82	0.84	0.81	0.84	0.89	0.88	0.82	0.92	0.82	0.82	0.86	0.8	0.88	0.92
0.82	0.82	0.82	0.82	0.81	0.8	0.69	0.92	0.82	0.9	0.96	0.82	0.81	0.9	0.89	0.86
0.82	0.72	0.76	0.82	0.81	0.84	0.89	0.86	0.8	0.82	0.9	0.82	0.92	0.9	0.89	0.92
0.8	0.82	0.78	0.82	0.81	0.8	0.89	0.84	0.9	0.92	0.82	0.82	0.81	0.84	0.94	0.92
0.62	0.82	0.82	0.82	0.81	0.84	0.89	0.92	0.86	0.88	0.9	0.82	0.81	0.94	0.89	0.98
0.6	0.62	0.62	0.82	0.81	0.84	0.89	0.72	0.82	0.82	0.82	0.9	0.81	0.84	0.9	0.92
0.82	0.72	0.82	0.62	0.81	0.84	0.79	0.92	0.82	0.82	0.88	0.82	0.81	0.84	0.89	0.92
M 0.76±0.011	M 0.774±0.01	M0.79159±0.013	M 0.81±0.011	M 0.802±0.005	M 0.823±0.006	M 0.863±0.01	M 0.853±0.01	M 0.829±0.017	M 0.836±0.01	M0.8675±0.013	M 0.825±0.011	M0.839±0.0125	M 0.853±0.011	M0.8885±0.0085	M 0.892±0.013

Here is 1 clinical example: Patient A., born in 1972, medical history No. 122/16 (2019). Admitted with complaints of pain and limited movement in both hip joints with lameness on both sides. The clinic diagnosed grade III ANFH of both hip joints.

Table 3.5

Dopplerographic data of the patient:

Left:	
Latent blood flow velocity in	Resistance index
circumflexa femoris medialis - 69.5 cm / s	RI-0,82
a. circumflexa femoris lateralis - 62.4 cm / s	RI-0.83
a. profunda femoralis - 95 cm / s	RI-0.89
a. femoralis -110 cm / s	RI-0,85
Right:	
Latent blood flow velocity in	Resistance index
circumflexa femoris medialis -110.2 cm / s	RI-0.81
a. circumflexa femoris lateralis - 45.8 cm / s	RI-0.84
a. profunda femoralis - 38.4 cm / s	RI-0.89
a. femoralis - m / s	RI-0.92

The study revealed that the walls of the common and superficial vessels of the femoral arteries were thickened, and the intima was compacted. The lumens of the common and deep femoral arteries were passable, and the main blood flow on both sides was not changed. In the left lower limb, the peripheral resistance in the arteries was increased, which shows a blood flow deficit in the hip joint on both sides.

Here is a 2nd clinical example: Patient B., born in 1985, case history No. 137/31 (2019). Admitted with complaints of pain and limited movement on the right in the hip joint, with severe lameness on the right. The clinic diagnosed: Aseptic necrosis of the heads of both femurs, grade IV.

Table 3.6

Doppler ultrasonography data of the resistance index of both hip joints.

Right:	
Latent blood flow velocity in	Resistance index
circumflexa femoris medialis - 36.2 cm / s	RI -0.82
a. circumflexa femoris lateralis - 48.9 cm / s	RI-0,70
a. profunda femoralis - 62.2 cm / s	RI-0,69
a . femoralis - 95 cm/s	RI -0.82
Left:	
Latent blood flow velocity in	Resistance index
circumflexa femoris medialis - 39.2 cm / s	RI-0,85
a. circumflexa femoris lateralis - 55.8 cm / s	RI-0,78
a. profunda femoralis - 81.4 cm / s	RI-0,82
a. femoralis - 105 cm / s	RI-0,80

The study revealed that the walls of the common and superficial vessels of the femoral arteries were thickened, and the intima was compacted. The lumens of the common and deep femoral arteries were passable, and the main blood flow on the right was not changed. In the left lower limb, the peripheral resistance in the arteries was increased, which shows a blood flow deficiency in the hip joint on the right. Conducting Doppler studies of the common femoral artery (CFA), superficial femoral artery (SFA) and deep femoral artery (DFA) in patients with ANFH initially shows a decrease in all parameters - peak systolic velocity (PSV) . and resistance index (RI) and pulsatility index (PI).

The indicators of these parameters make it possible to determine the quantitative characteristics of blood flow in the studied vessels. Comparative characteristics show that all the parameters differed reliably from the data of the healthy limb. Based on the indicators of the Doppler study, it is possible to conclude that there is a circulatory disorder in the hip joint with ANFH diffuse changes in the blood flow velocity of the vessels in the studied vessels , which is expressed by an unequal sequence of changes in their parameters.

Thus, the Doppler ultrasound examination indicators were changed mainly towards a decrease.

Duplex scanning of the vessels of the hip joint area in the disease of ANFH allows predicting the development of aseptic necrosis . In case of aseptic necrosis of the femoral head, Dopplerography makes it possible assess the state of blood circulation of the femoral head and determine the blood flow velocity in the pathological focus. Currently, ultrasonography with Dopplerography helps to clarify the diagnosis and choose the tactics of surgical treatment. This technique makes it possible to assess the blood circulation of the lower extremities and determine the blood flow velocity. Despite this, this technique remains poorly studied in ANFHBH to assess changes in blood flow in the pathological focus, as well as to determine the regional blood supply to the femoral head.

Thus, Dopplerography provides the ability to examine vessels and diagnose the level of vascular disorders, which allows for blood flow assessment and differentiation of the stages of the pathological process in the hip joint of the medial angle of the inguinal ligament. Minimal distortion of the ultrasound signal is noted where the vessels are closest to the skin surface.

One of the reliable methods of instrumental examination in ANFH of the hip joint is MRI examination. Specificity, sensitivity and accuracy of this method reach up to 100%. Incredibly high diagnostic efficiency, incomparable with other clinical diagnostic tests, harmlessness of the examination (absence of radiation exposure, unlike computed tomography (CT) and X-ray diagnostics), high placement capacity (ability to distinguish objects up to several millimeters in size and obtain an image in any projection), give MRI a well-deserved first place in the diagnosis of patients with osteonecrosis of the femoral head.

All patients underwent MRI of the hip joint. The majority of patients were of working age. Based on MRI examination, hip joint damage was detected, which was divided into 4 stages. In 22 (8%) patients with stage I ANFH, MRI data revealed deformation of the joint space in the anterior superior sector of the joint due to uneven narrowing of the height of the hyaline cartilage of the femur. The cartilage structure was inhomogeneous due to the inclusion of high-intensity MRI signals. MRI provides a bright image of the cartilage while maintaining a clear contract between the cartilage and other tissues. Clear differentiation of the cartilage of the synovial membrane and joint effusion in osteonecrosis of the femoral head is achieved in the 3D gradient echo mode with suppression of the fat tissue signal in T 1 - weighted images, without requiring the use of contrast.

The MRI method showed that the thickness of the femoral articular cartilage in healthy young adults decreases by 0.6 mm during the day. In other areas experiencing lower biochemical loads, the cartilage thickness does not change . The three-dimensional organization of collagen in hyaline cartilages has a strong effect on the MRI image due to the limited mobility of water, which leads to changes in signal intensity correlating with the thickness of the sample under study. Measurement of cartilage thickness by MRI in the gradient echo mode with a three-dimensional signal collection method provides good correction with anatomical data, except for the hip area, where the discrepancy reaches 0.41 mm, indicating the need to improve the method for all cases where cartilage thickness is of clinical importance, Figure 3.6.

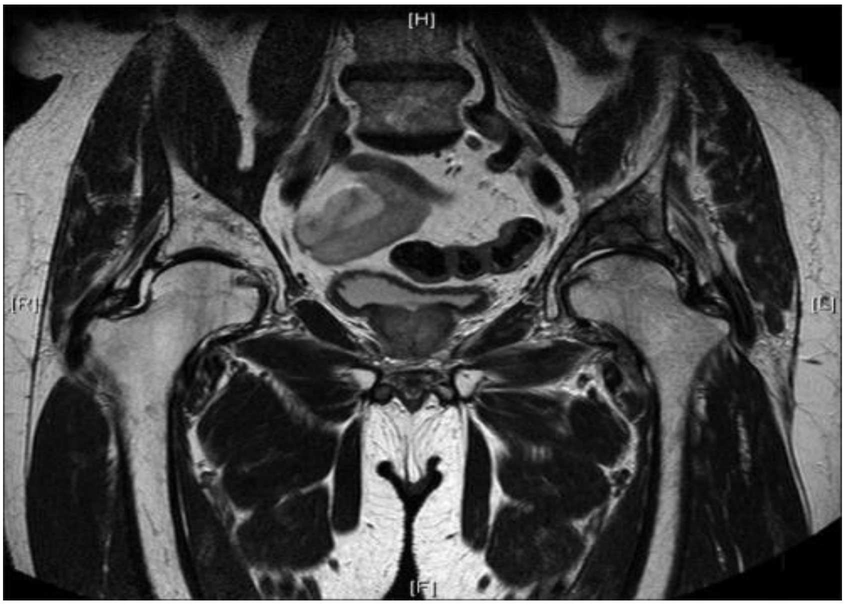


Figure 3.6 MRI of patient R.U., 1980, No. IB 126/28, with stage I ANFH .

In 83 (32%) patients with stage II ANFH, we determined in MRI compaction and change in the shape of the femoral head, chondromalacia of the hyaline cartilage, and local minor calcification of the ligament-capsular apparatus. Using MRI, it is possible to assess with high accuracy the femoral groove both at the level of the subchondral bone and at the level of the articular cartilage, Figure 3.7.

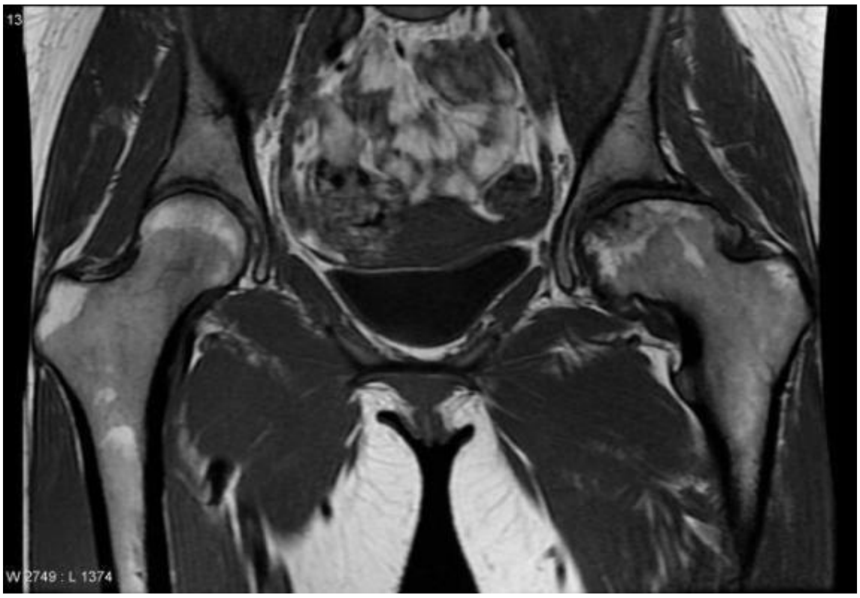


Figure 3.7 MRI of patient S.A., born in 1981, No. IB 199/61, with stage II ANFH .

According to MRI data, 84 (33%) patients with stage III ANFH had deformation, cystic restructuring of the femoral head, and weak calcification of the ligament-capsular apparatus, Figure 3.8.

Figure 3.8 MRI of patient M.Sh., born in 1968. No. IB 746/46 with ANFH III - stages.

In 70 (27%) patients with stage IV ANFH, compaction of the femoral head nucleus was detected. Fragmentation is noted - the epiphysis is destroyed, at first there is deformation of the epiphysis in the lateral part of the cartilage, and then bone islands that merge with the epiphysis. Metaphyseal changes are observed in the form of small and large - cystic structural disorders of leaf-shaped enlightenments. At this stage, decentration of the femoral head, lateroposition of the femoral head, absence of joint decompression, widening of the femoral neck with gradual flattening and shortening are also noted. The roof of the acetabulum is beveled, and its upper edge is also sharpened. Paraarticular soft tissues are pronounced calcified, Figure 3.9.

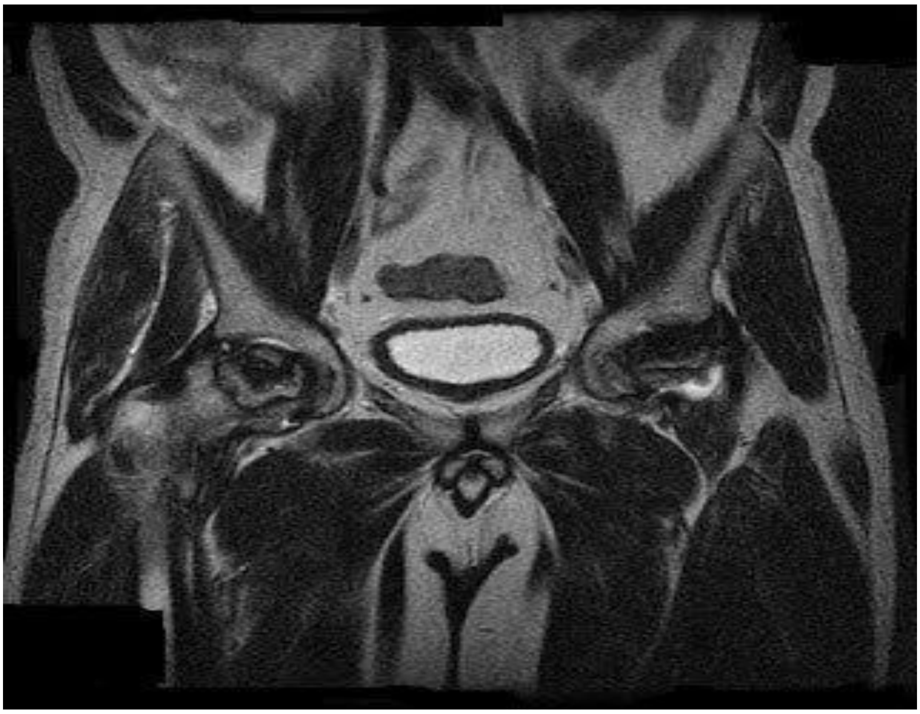


Figure 3.9 MRI of patient B.A. born in 1958, No. IB 03773/214 with stage IV ANFH .

Thus, MRI examination of the hip joint in ANFH allows for an objective assessment of the condition of the joint ligament apparatus, cartilaginous surfaces and monitoring the effectiveness of conservative and surgical therapy.

MRI is the most useful, non-invasive method in the diagnosis of ANFH. Based on MRI research, it is possible to identify Stage IV hip joint damage. MRI is the best and most objective method for determining the indications for conservative and surgical treatment.

We also used MRI examination before and after treatment with denervation and plasma lifting to determine the % of damage to the femoral head using the program (Vidar Dicom Viewer 3.2).

Table 3.7.

Percentage damage to the femoral head on MRI before and after treatment with plasma lifting.

Stage I				Stage II				Stage III				Stage IV			
Before	After	In 6 months	In a year	Before	After	In 6 months	In a year	Before	After	In 6 months	In a year	Before	After	In 6 months	In a year
11	11	7	6	25	25	23	18	47	47	35	33	72	72	66	61
13	12	8	7	23	23	21	19	51	49	49	49	76	76	73	66
14	12	12	11	18	16	14	13	45	44	43	41	61	61	61	61
7	7	5	5	20	19	16	16	37	36	36	36	64	61	56	53
14	12	11	9	23	20	19	17	48	46	43	42	59	59	56	56
M11.8±1.4	M10.8±1	M8.6±1.4	M7.6±1.2	M21.58±0.75	M20.58±0.75	M18.5±0.83	M16.75±0.83	M42.08±1.67	M40.17±1.67	M37.58±1.92	M35.42±2.33	M66.4±3.4	M65.8±3.4	M62.4±3.4	M59.4±2.6
p >0.1		p <0.01	p <0.001	p >0.1		p <0.001	p <0.001	p >0.1		p <0.01	p <0.001	p >0.1		p >0.1	p <0.01

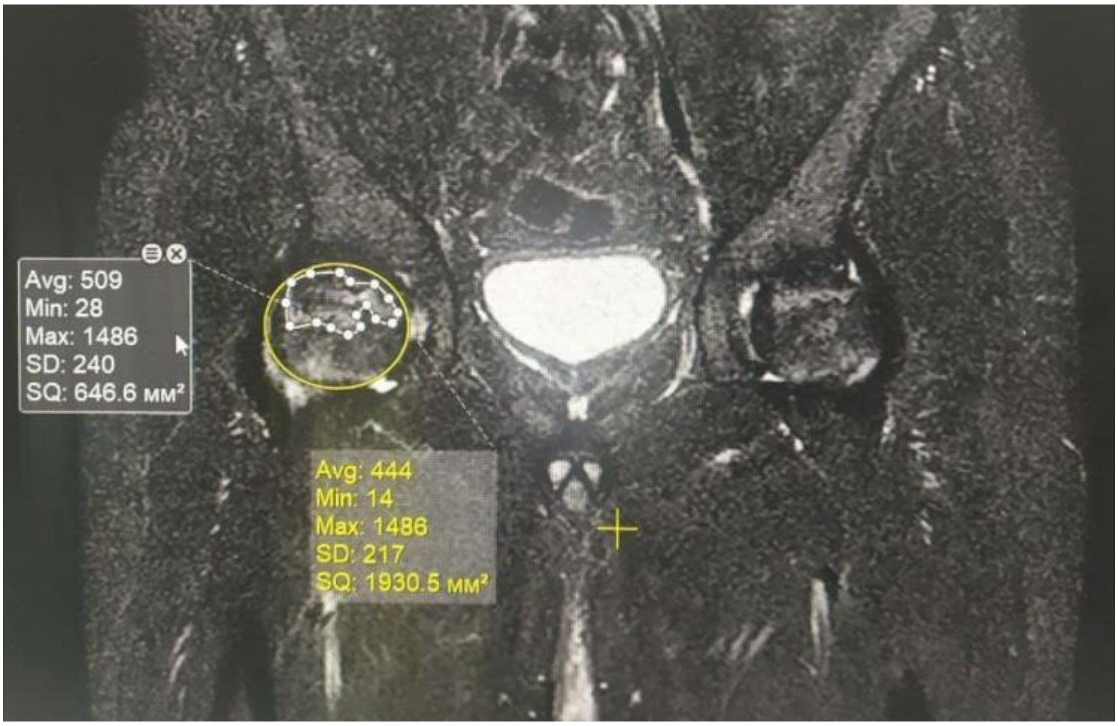


Figure 3.10 MRI of patient M.Yu., born in 1963, No. IB 9163/870, with stage III of ANFH disease before plasma lifting.

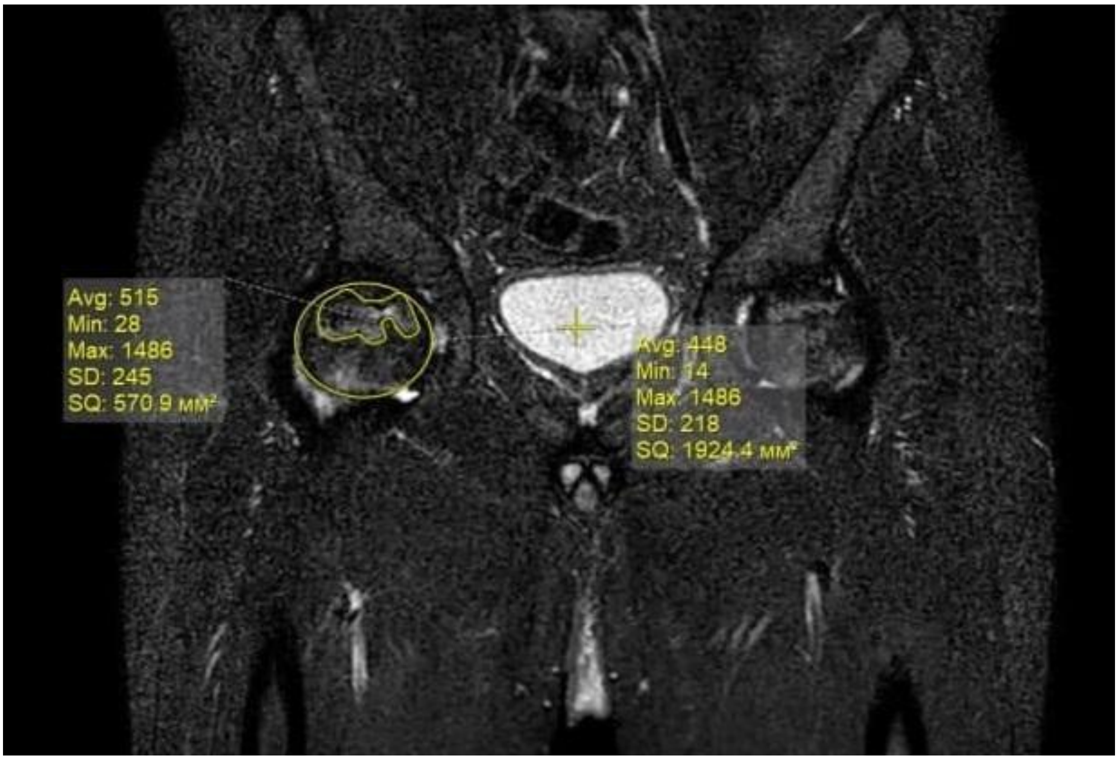


Figure 3.11 MRI of patient M.Yu., born in 1963, No. IB 9163/870, with stage III of ANFH disease, 6 months after plasma lifting.

From this table it is clear how the percentage of damage to the femoral head changes when using the plasma lifting method for ANFH. If you pay attention to the results , you can say that the best stage for carrying out the plasma lifting method is stage I - II of the disease.

Table 3.8

Percentage damage to the femoral head on MRI before and after denervation treatment.

Stage I				Stage II				Stage III				Stage IV			
Before	After	In 6 months	In a year	Before	After	In 6 months	In a year	Before	After	In 6 months	In a year	Before	After	In 6 months	In a year
10	10	5	4	24	24	22	17	46	46	34	32	70	70	65	60
12	11	7	6	22	22	22	20	50	48	48	48	75	75	72	65
13	11	11	10	17	15	15	15	44	43	42	42	60	60	60	60
6	6	3	3	19	19	15	15	35	34	34	34	63	60	55	52
13	11	10	7	24	21	20	18	47	45	42	41	58	58	55	55
M 1 0 , 33 ± 0 , 67	M 9,5 ± 0,6 7	M 7,5 8 ± 0,7 5	M 6,0 0 ± 0,5 89	M 2 0 , 92 ±0 .75	M 20, 00 ±0 , 83	M 2 8, 2 5 ±0. 83	M 16, 42 ±0 , 92	M 41 , 25 ±1 , 50	M 39 , 42 ±1 , 58	M 3 6,0 7 ± 1.9 2	M 3 4 , 58 ±2 .33	M 6 1,0 8 ± 2,0 0	M 59, 67 ± 2,0 8	M 55, 92 ± 2,6 7	M 51 , 92 ±2 , 42

$p>0.1$	$p<0.01$	$p<0.001$	$p<0.01$	$p>0.1$	$p>0.1$	$p<0.001$	$p<0.01$	$p>0.1$	$p>0.1$	$p<0.01$	$p>0.1$	$p>0.1$	$p>0.1$	$p<0.001$	$p>0.1$

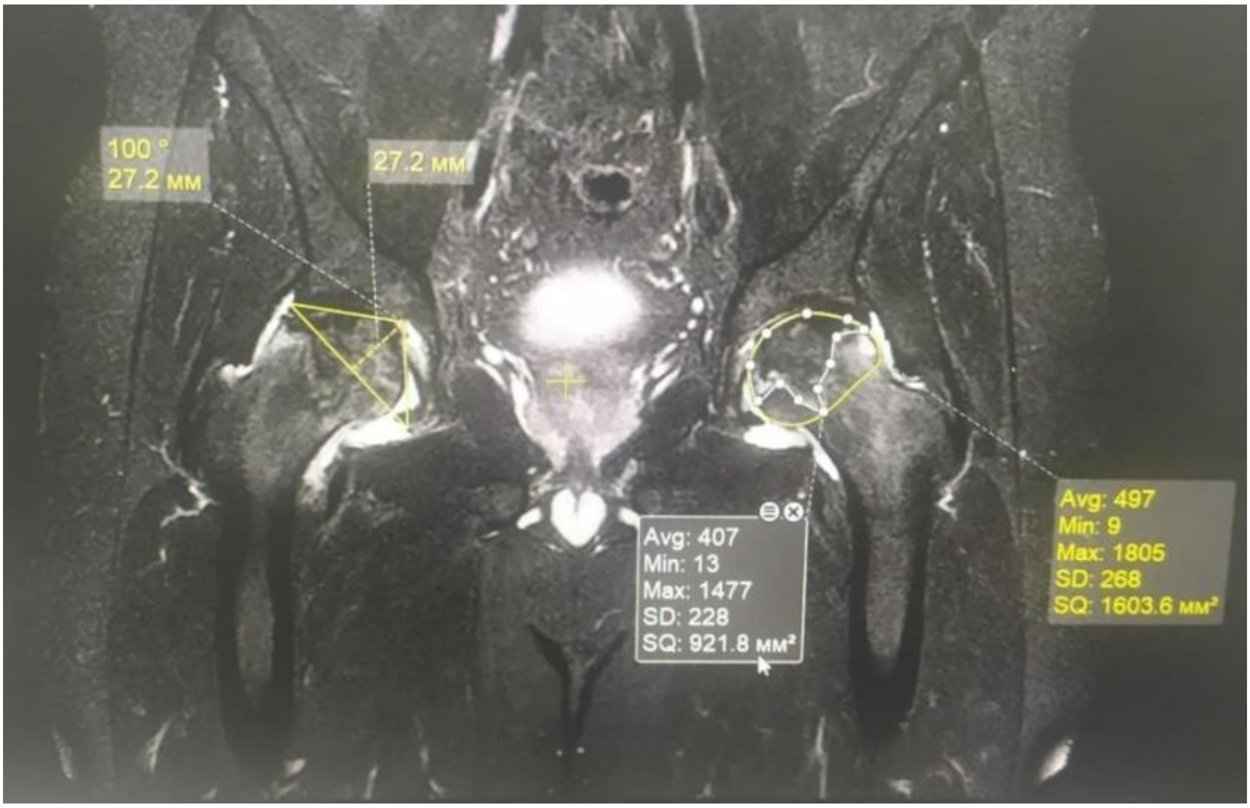


Figure 3.12 MRI of patient I.O. 1978 No. IB 3761/431 with stage II of ANFH disease before denervation.

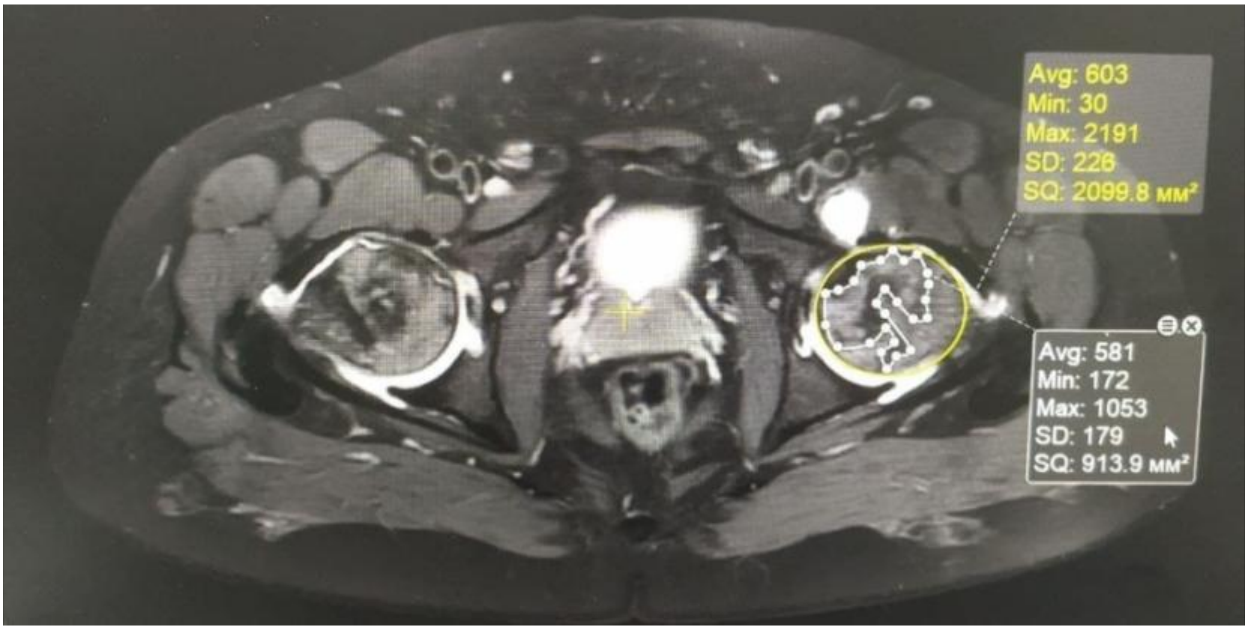


Figure 3.13 MRI of patient I.O. 1978 No. IB 3761/431 with stage II of the disease ANFH 6 months after denervation.

From this table it is clear how the percentage of damage to the femoral head changes when using the denervation method for ANFH. If you pay attention to the results , you can say that the best stage for carrying out the denervation method is I - II - III stage of the disease.

Ultrasound densitometry.

ANFH refers to a group of pathologies in which bone tissue becomes fragile. 76 patients with this pathology with 4 stages of the disease were included in the examination. Patients with stage I made up – 10 (13 %) , with stage II – 20 (26%), III – 31 (41%) and stage IV 10 (20 %).

Table 3.9

Distribution of patients bone mineral density

WHO criteria	I Art.	II Art.	III Art.	IV Art.
Norm	2 (20 %)	5 (25 %)	5 (17 %)	0
OYA	3 (30 %)	5 (25 %)	11 (35 %)	4 (27 %)
OP	5 (50 %)	10 (50 %)	15 (4 8%)	11 (73 %)
Total	10 (13 %)	20 (26 %)	31 (41 %)	15 (20 %)

Table 3.9 shows that normal values for the mineral plane of bone tissue were determined in most cases in children with stages I and II of the disease in 15 cases. Values corresponding to osteopenia for bone mineral density were noted among patients with III , IV stages of the disease in 15 and 11 cases, which indicates a decrease in the role of mineralization in osteonecrosis of the femoral head.

Correlation analysis of data between the IPC with the age of patients and the duration of the disease shows a dynamic decrease in the IPC with increasing age of patients and the duration of the disease. When studying patients, it was found that the greater the age of the patient and the duration of the disease, the lower the IPC. Ultrasound densitometry indicators a similar correlation is noted in the age aspect and duration of the disease in relation to the risk of fracture, a positive correlation relationship is determined between age, duration of the disease and densitometric risk of fracture. Thus, with an increase in the age of patients and duration of the disease, a deterioration in the condition of the bone tissue of the radius and the development of OC and OP are noted, which is confirmed by a comparative and correlation analysis of these studies. At a late stage of the disease, a direct correlation relationship is noted in the correlation and comparative analysis of the dependence of the BMD by the T-criterion on ANFH (Table 3.10).

Table 3.10

Age dynamics of the VO2 max according to SOS depending on age.

Groups and IPC	SOS indicators in the age aspect distal forearm			
	35-45 years old	46-55 years old	56-65 years old	66 years and older
	Main group	Main group	Main group	Main group
T-score, SD	-2.2	-2.08	-1.8 0	-1.6
SOS	3 839	3 601	3 685	3 7 0 5

In the age aspect, the dynamics of the decrease in the BMD depending on the increase in the age of patients with ANFH was noted. The PC determined the level of mineral density of the distal radial bone tissue. Z - score is the number of standard deviations in the difference between the average indicator in individuals of the corresponding sex and race. The obtained data were analyzed, then the average values and standard deviations were determined using the method of variation statistics. When analyzing the densitometry results, it was noted that the BMD level decreased depending on the age of patients and the duration of the disease. The BMD in patients of the study group aged 55-66 and older was significantly lower. In patients 25 - 36 years old, the BMD deviation from the norm was noted less often.

We give the following example: patient M., born in 1980, IB (No. 654/24) with a diagnosis: Bilateral ANFH stage III .

Upon admission, the patient complained of pain and limited movement in the area of both hip joints, more on the right, and lameness.

Densitometry was performed on September 20, 2018, according to the standard program. The study revealed a decrease in the indicators, the T-score and Z-score in the area of the distal end of the radius are reduced, which is more pronounced (Figure 3.14).

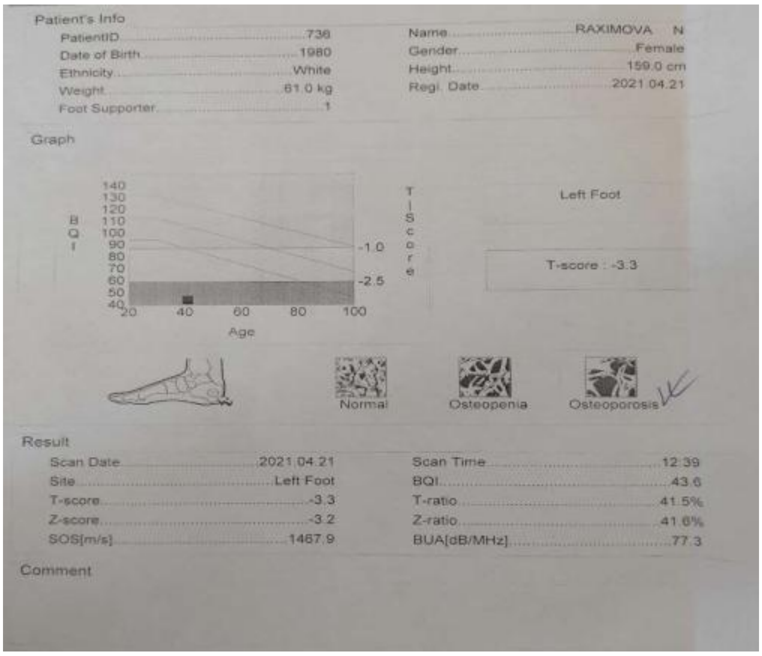


Figure 3.14 Densitogram of patient M. with diagnosis: Aseptic necrosis of the heads of both femurs Stage III .

Thus, the results of densitometric studies allowed us to draw the following conclusions: when examining patients with bilateral coxarthrosis and ANFH, with adduction contracture stage III, sclerosis, deformation of the femoral head and the presence of a subchondral cyst are observed, a decrease in the BMD of the limb on the affected side was revealed (T-score and Z-score on average = -2.0) in 64.5% of cases of stage IV with partial and complete fibrous fusion of the joint, which is more often was observed at the age of 55-66 years (T-score and Z-score on average = -1.6) in 78% of cases. Analysis of the densitometry results showed that the level of BMD reduction before treatment was sharply reduced. BMD in 12 of 24 patients with stage 4 of the disease showed a decrease in BMD T-score and Z-score below -1.6.

Thus, statistical analysis of the obtained densitometric data between age groups of patients with terminal stages of the disease revealed a decrease in BMD accordingly with increasing age, duration and stage of the disease. This indicates that without load on the lower limb, an increased decrease in BMD is observed.

Development of a treatment and diagnostic algorithm for patients with ANFH

After analyzing the clinical and functional parameters and instrumental examination data according to the stage of the disease, we selected a treatment method according to the diagnostic and treatment algorithm we developed, for which a certificate was received from the Intellectual Property Agency of the Republic of Uzbekistan No. DGU 2021 0122 (01/19/2019) (program for choosing treatment tactics for ANFH).

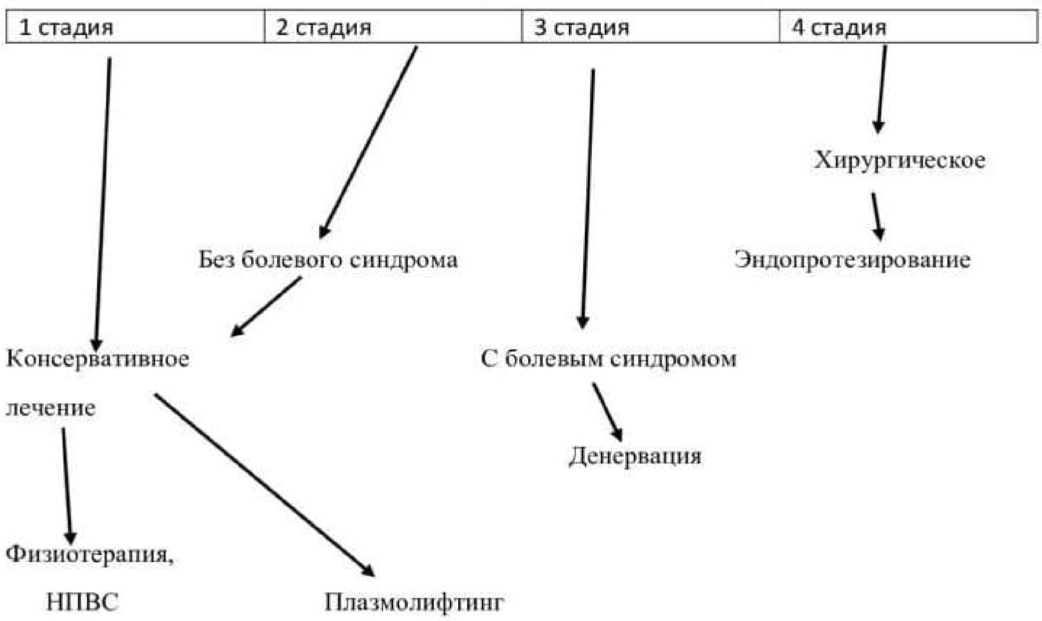


Figure 3.15. Scheme of the algorithm for diagnosis and treatment of patients with ANFH by stages of the disease.

Conclusion to the chapter.

The main clinical manifestation of aseptic necrosis is pain. With ANFH, pain in the groin area sometimes radiates along the anterior surface of the thigh to the knee joint. There is also a combination of pain in the hip area with pain in the lower back and gluteal region. Pain in the knee area gives a picture of arthrosis of the knee joint. Most often, the disease manifests itself as a limitation of rotational movement in the hip joint. Then there is a limitation of abduction, and finally - a decrease in flexion. In the third and fourth stages, shortening of the limb, curvature of the pelvis, flexion-adduction contracture in the joint, and hypotrophy of the thigh muscles are determined.

Upon admission of patients, functional indicators were assessed by clinical parameters on a 5-point scale, the clinical result was assessed by analyzing the sum of points. Good was within the range of 15 to 22 points, satisfactory - from 8 to 14; unsatisfactory was assessed by a sum of 0 to 7 points.

Radiographs are negative in the early stages of the disease. Typically, there is initially mild osteopenia, followed by variable changes such as patchy sclerosis and rim calcification. Gradually, microcracks in the subchondral bone accumulate in dead bone that fails to regenerate, leading to collapse of the articular surface and the appearance of the crescentic sign of osteonecrosis. Eventually, the cortex is destroyed and fragmented, with superimposed secondary degenerative changes.

Dopplerography provides opportunities to assess the blood circulation of the lower extremities and determine the blood flow velocity in the pathological focus, as well as to determine the regional blood supply to the femoral head. Currently, to clarify the diagnosis and choose the tactics of surgical treatment . Ultrasonography with Dopplerography helps

MRI examination of the hip joint in ANFH allows for an objective assessment of the condition of the joint ligament apparatus, cartilaginous surfaces and to observe the effectiveness of conservative and surgical therapy.

MRI is the most useful, non-invasive method in the diagnosis of ANFH. Based on MRI examination, 4 stages of hip joint damage can be identified. MRI examination is the best and objective method for determining the indications for conservative and surgical treatment.

CHAPTER 4. CONSERVATIVE TREATMENT OF PATIENTS WITH ASEPTIC NECROSIS OF THE FEMORAL HEAD.

§ 4.1. Methods of conservative treatment of patients with aseptic necrosis of the femoral head.

Modern methods of treatment for ANFH currently use enriched platelet plasma (EPP) is very promising. EPP contains alpha granules of platelets with growth factor. Which gradually goes into the surrounding tissue, they improve regeneration or recovery process with an effect on the inflammatory process. Thanks to this powerful out cocktail, the maximum effect is achieved for removing inflammation, improving regeneration, stimulating local immunity and increasing local blood supply. The data obtained when introducing ORP is relevant in its judgment depending on the results and the stage of the disease.

Under our supervision from 2015-2021 in the department of orthopedics and consequences of injuries of the BOMPMTS and the private clinic " Star Orthomed " 101 patients with ANFH who were treated with platelet-rich plasma (PRP) developed by us. The patients underwent MRI, ultrasound, Dopplerography and X-ray examinations. All patients underwent standard conservative treatment using physiotherapy and drugs (magnetic therapy, UHF, laser therapy, paraffin applications, massage, NSAIDs, decongestants that improve microcirculation in soft tissues, muscle relaxants), and intra-articular plasma lifting was also performed using the technique developed by us in the clinic. The patient's blood is taken from a peripheral vein using a 10.0 ml syringe under aseptic conditions. The blood is centrifuged in special vacuum tubes at 3200 rpm for 5 minutes. Then the enriched plasma, which is in the upper layer of the tube, is taken into a syringe and injected into the hip joint under local anesthesia along the anterior surface of the joint. This procedure was carried out on the 1st, 7th, 14th, 21st days in the main group. And in the control group, the centrifuge rotation was 3700 for 10 minutes.

§ 4.2 Evaluation of the results of using platelet-rich plasma after conservative treatment in patients with aseptic necrosis of the femoral head

Remote results were studied in all 101 patients. The main symptoms are pain, mobility, and the patient's walking. The average observation period with remote results is from 1 to 2 years, the treatment results were assessed using the Obereg scale.

These signs were divided into 3 categories: assessed by 11 and 12 points each. We assessed the total scores of patients before and after hip joint treatment. To study the functional effect in patients before and after treatment with the use of platelet rich plasma (PRP) The pain characteristics were assessed according to 7 criteria (from 0 to 6 with an increase, i.e. from the absence of pain – 11-12 points, to severe and constant – 0 points):

- the degree of mobility of the hip joint was assessed as normal more than 90 degrees, with abduction up to 30 degrees - 11-12 points to ankylosis in a vicious position - 0 points;

- the walking condition was assessed from 11-12 points, when the patient could not walk – 0 points;

- By summing up the scores for the parameters - pain, mobility, walking - we assessed the results of the functional state of the hip joint;

If the result of the sum of points is 11-12 it is assessed as very good, with 10 points – good; 9 points – average; 8 points – mediocre ; 7 points or less – bad (table 4.1).

Table 4.1

Severity of pain syndrome in patients with ANFH before and after treatment with plasma lifting.

Nature of pain	The degree of pain syndrome in points						
	With ANFH patients stage I-II		With ANFH patients stage III-IV		Total		Normative
					beginning and after		meaning of points
					treatments		
	beginning of treatment	after treatment	beginning of treatment	after treatment			
No pain	0	21	0	0	0	16	11
mild or infrequent pain, normal activity	13	20	0	10	9	24	9
slight pain when walking, quickly disappears during rest	21	19	4	5	20	18	7
tolerable pain that limits activity	19	4	7	1	22	2	5
severe pain when walking, precluding any activity	10	0	4	0	8	0	3
severe pain even at night	2	0	1	0	2	0	1
pronounced and constant	0	0	0	0	0	0	0
Total	45(65)	44(64)	16(36)	16(36)	101	100	
Average score	6.24	9.05	4.75	8.13	5.85	8.8	
M	6.24±0.35	9.05±0.36	4.75±0.4	8.13±0.63	5.85 ±0.36	8.80 ±0.4	
P	P<0.001		P<0.001		P<0.001		

As can be seen from Table 4.1, after treatment Of 101 patients with ANFH, the following were noted: 26 patients had mild or rarely occurring pain, normal activity; 45 patients had minor pain during walking, which quickly disappeared during rest; 4 patients had tolerable pain, limiting activity; 1 patient had severe pain during walking, excluding any activity. Severe night pain, both severe and constant, was not observed. Severe night pain, both severe and constant, was not observed.

We also studied the degree of mobility of the hip joint in the observed patients after plasma lifting (Table 4.2).

Table 4.2

The degree of mobility in patients with ANFH of the hip joint before and after plasma lifting treatment.

Degree of mobility	Hip joint mobility degree in points						
	1 stage		2 stages		Total		Normative the meaning of points
	Start of treatment	After treatment	Start of treatment	After treatment	start	after	
flexion : more than 90 degrees, abduction: up to 30 degrees	0	18	0	0	0	18	11
flexion: 80–90 degrees, abduction: less than 15 degrees	25	36	4	24	29	60	9
flexion: 60 – 80 degrees the patient can reach the foot	28	10	15	12	43	22	7
flexion: 40 – 60 degrees	12	0	14	0	26	0	5
flexion less than 40 degrees position	0	0	3	0	3	0	3

no movement, slight deformation	0	0	0	0	0	0	0
Total	**65**	**64**	**36**	**36**	**101**	**100**	
Average score	7.4	9.55	6.11	8.3	6.9	8.9	
M	7.40 ± 0.4	9.55 ± 0.55	6.11± 0.4	8.33± 0.6 7	6.94 ± 0.42	8.92 ± 0.6	
P	p <0.001		p <0.001		p <0.001		

Table 4.2 shows that after treatment with ANFH stage 1 and 2 out of 65 patients the following was observed: in 25 patients flexion: 80 – 90 degrees, abduction: less than 15 degrees; in 28 patients flexion: 60 – 80 degrees the patient can reach the foot; in 12 patients flexion: 40 – 60 degrees. Flexion less than 40 degrees, mild deformation and no ankylosis in the vicious position.

The degree of restoration of the function of the affected joint was also judged by walking.

Table 4.3

Evaluation of walking status in patients with ANFH before and after plasma lifting treatment.

Walking condition	Walking condition assessment in points						
	I-II stages		III-IV stages		Total		Normative
	ANFH		ANFH		beginning of treatment	After treatment	the meaning of points
	Start of treatment	After treatment	start treatments	After treatment			
norm	4	25	0	0	4	25	11
no cane, but has a slight limp	28	35	5	21	33	56	9

with a cane - can walk for a long time, for a short time - without a cane and limping	17	4	18	13	35	17	7
using one cane less than 1 hour; difficult - without a cane	8	0	9	2	17	2	4
only with the help of canes	8	0	2	0	10	0	3
only with the help of crutches	0	0	2	0	2	0	2
can't walk	0	0	0	0	0	0	0
Total	65	64	36	36	101	100	
Average score	7.25	9.66	6	8	6.81	9.06	
M	7.25± 0.4 4	9.66 ± 0.61	6.03 ± 0.5	8.00 ± 0.5	6.81 ± 0.39	9.06 ± 0.55	
P	p<0, 0 01		p<0, 0 1		p<0.0 0 1		

Table 4.3 shows that after treatment with ANFH out of 101 patients the following was noted: in 25 patients walking became normal; 35 patients walked without a cane, but with a slight limp; 4 patients with a cane could walk for a long time, for a short time - without a cane and limping. There were no patients who only used a cane or walked only with crutches .

All patients under observation were assessed for pain severity, mobility and walking conditions before treatment. After treatment, joint pain gradually decreased and joint mobility and walking improved, indicating the effectiveness of platelet-rich plasma in ANFH.

Thus, all patients underwent standard conservative treatment using physiotherapeutic and medicinal preparations (magnetic therapy, UHF, laser therapy, paraffin applications, massage, NSAIDs, decongestants, drugs that improve microcirculation in soft tissues, muscle relaxants), and intra-articular plasma lifting was also performed using the technique developed by us in the clinic.

We evaluated the results of treatment with platelet-rich plasma in ANFH in the immediate period after conservative treatment according to the Oberg scale. (table 4.4).

Table 4.4

Evaluation of the treatment results using platelet-rich plasma in ANFH in the near future after conservative treatment according to the Oberg scale.

Grade	With AGNBC stages I-II		With AGNBC stages III-IV			
	n	M (%)	n	M (%)	n	M (%)
Very good (11-12)	36	80	8	50	44	72
Good (10)	8	17	5	31.25	13	21
Satisfactory (9)	1	3	2	12.5	3	6
Unsatisfactory (7 or less)	1		1	6.25	1	1
Total	45	100	16	100	61	100
M	45±0.8		16±0.44		61±0.7	
P	P<0.001		P<0.001		P<0.001	

Table 4.4 shows that the results of 101 (100%) patients with ANFH stage I - II were studied ; very good results were obtained in 36 (80%), good in 8 (17%), satisfactory 1 (3%). In total, 44 (72%) very good results, 13 (21%) good, 4 (6%) satisfactory results were obtained. These indicators indicate the effectiveness of the use of platelet-rich plasma in ANFH stages 1 and 2, i.e. in the initial stage of the disease.

Conclusion to the chapter.

Modern methods of treatment for ANFH currently use enriched platelet plasma (EPP) is very promising. EPP contains alpha granules of platelets with growth factor. Which gradually goes into the surrounding tissue, they improve regeneration or reparative process with the effect on the inflammatory process. All patients underwent standard conservative treatment with the help of physiotherapeutic and medicinal preparations (magnetic therapy, UHF, laser therapy, paraffin applications, massage, NSAIDs, decongestants that improve microcirculation in soft tissues, muscle relaxants), and intra-articular plasma lifting was also performed using the technique developed by us in the clinic.

To study the functional effect in patients before and after treatment with the use of plasma lifting platelet rich plasma (PRP) The pain characteristics were assessed according to 7 criteria (from 0 to 6 with an increase, i.e. from the absence of pain - 11-12 points, to severe and constant - 0 points). The degree of mobility of the hip joint, walking in the observed patients before and after surgery was also studied

All patients under observation were assessed for pain severity, mobility and walking conditions before treatment. After treatment, joint pain gradually decreased and joint mobility and walking improved, indicating the effectiveness of platelet-rich plasma in ANFH.

In 89.2% of patients with ANFH, after treatment, they received good and very good treatment results. The duration of remission increased for at least 6 months. In 1 (1%) patient, there was unsatisfactory result because the patient did not receive the full course of treatment and did not comply with the standard of treatment.

CHAPTER 5. SURGICAL METHODS OF TREATMENT OF PATIENTS WITH ASEPTIC NECROSIS OF THE FEMORAL HEAD

§ 5.1 Minimally invasive surgery, neuroablation.

Surgical treatment of ANFH is one of the most difficult problems of modern orthopedics. Deformation due to ANFH is aggravated in the duration and development of the disease, i.e. the articular surface becomes incongruent . We have ANFH I and II stage, neuroablation was performed. Recently, a modern new innovative method has been used for severe pain syndrome against the background of ANFH (ablation). The method of radiofrequency neuroablation (RFA) is used to reduce pain in the hip joint and knee joint, as well as when it is impossible to replace the joint. Ablation (denervation of sensory nerves) is a new, simple and more effective method of treatment. RF denervation of sensory nerves of the hip joint - in ANFH . The most widely used method is RF ablation (RFA) of the obturator and femoral nerves in osteoarthritis of the hip joint and knee joint without surgery. RFA is a safe and effective method of treatment that provides long-term pain relief. With this method, there is an interruption of transmission from the affected organ by nociceptive signals to the central nervous system. The electric current generated by radiofrequency waves contributes to the heating of a small area of nerve tissue, while degeneration of a specific area is noted and pain signals are reduced.

Ablation is a new simple and more effective method of treatment. RF denervation of sensory nerves of the hip joint - in the treatment of ANFH of various stages. Of the latest, the most widespread method is RF ablation (RFA) of the obturator and femoral nerves in ANFH without surgery.

The patient is placed strictly on his back on a multifunctional orthopedic table. Local anesthesia is administered with 2% novocaine - 2.0 lateral 1.5-2.0 cm from the femoral artery. (Fig. 5.1.A). Under the control of an electron-optical converter (EOC) at a distance of 45 cm at an optical angle of 15^{0} - 20^{0} G18 needle is inserted to the upper lip of the joint capsule for stimulation and negative aspiration, 2.0 ml of 5% n ovocaine is injected . (Fig. 5.1.B). After inserting the active end of the 22 G electrode of the device (COSMAN) , the 100-mm needle is advanced at an angle of 45 ^{0} to the n . femorale at the level of the upper lip of the joint capsule, using exactly the same method we reach n . obturatoris at an angle of 60 ^{0} .(Fig.5.1.C). Resistance is from 400 to 500 Ohm. Sensory testing up to 0.40 Mv, 50 Hz, describes the patient's sensation of pressure, which corresponds to the usual spread of pain in the patient. After receiving a motor response of up to 3 Mv at 2 Hz, which should be negative. Then we perform denervation (TRF) at 90 ^{0} C for 90 seconds (Figure 5.1.D).

Fig. 5.1. A

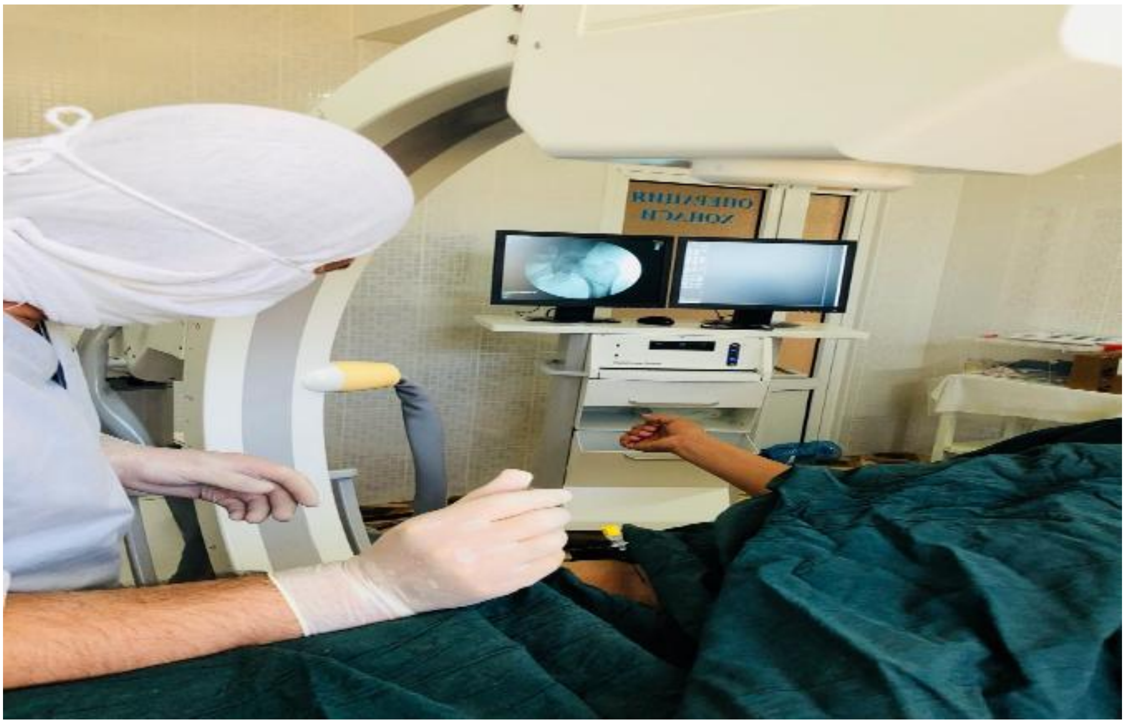


Fig. 5.1. B

Fig. 5.1. C

Fig. 5.1. D

Figure 5.1. Technique and stages of neuroablation.

This method is simple, with this technique, in addition to local anesthesia, no hip joint blockade is used, and various hormones and any hyaluronic acid are not used during its implementation. Regardless of its cause in the area of the hip joint and , after the point application of electric current waves to the nerves, patients feel a significant reduction in pain in the pelvic area.

Indications for the use of this technique are:

1. Degenerative joint diseases;
2. ANFH;
3. Total hip and knee replacement
4. In case of concomitant diseases, hip endoprosthetics is contraindicated.

This method provides pain relief, restores joint functions, with few complications and a reduction in the use of painkillers. Since patients have systemic diseases, severe concomitant pathology and there are restrictions on performing hip joint endoprosthetics, in such cases the RFA method can be used (Figure 5.2).

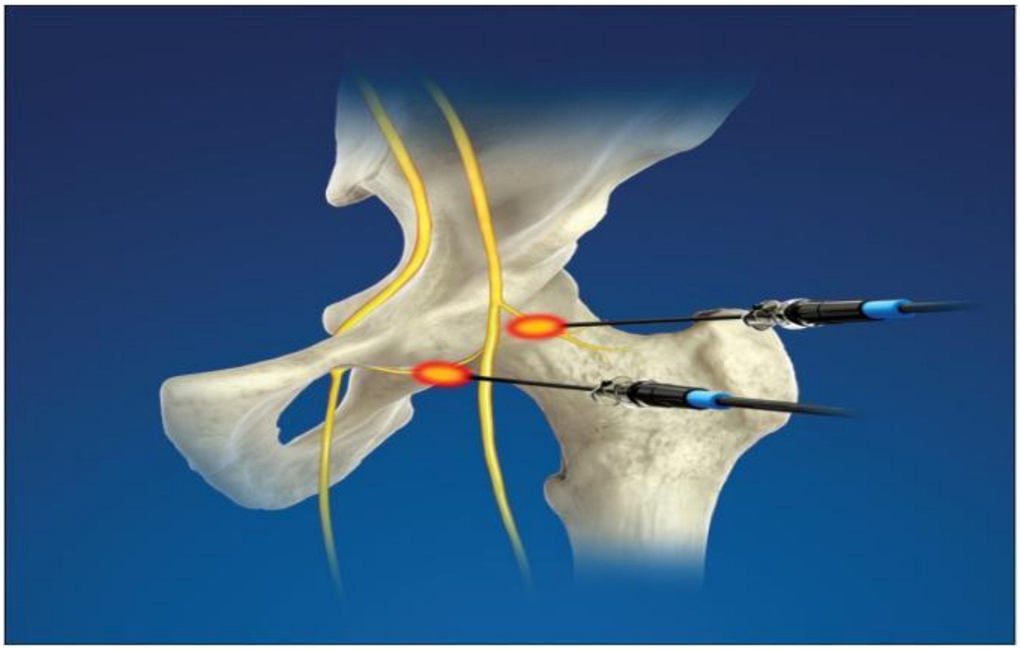


Figure 5.2. Schematic representation of the neuroablation procedure.

The functional state of patients before and after neuroablation treatment was assessed using a scale developed by us taking into account pain sensation (from 0 to 7 in ascending order, i.e. from no pain – 11-12 points, to severe and constant – 0 points) . – the degree of mobility of the hip and knee joint was assessed as normal over 90 degrees, with abduction up to 30 degrees – 11-12 points to ankylosis in a vicious position – 0 points. The assessment of the state of walking was assessed from 11-12 points, when the patient could not walk – 0 points. Summing up the points for the parameters – pain, mobility, walking, we assessed the results of the functional state of the hip and knee joints. The result of the sum of points 11-12 was assessed by us as very good, 10 points – good; 9 points – average; 8 points – mediocre ; 7 and less points – bad.

The severity of the pain syndrome shows the effectiveness of this method, that the pain immediately decreases for a long time and the patients' ability to work is restored faster.

Table 5.1

Severity of pain syndrome in patients with ANFH of the hip joint before and after neuroablation.

Nature of pain	The degree of pain syndrome in points: I-II stages, Before treatment	I-II stages, After treatment	III-IV stages, Before treatment	III-IV stages, After treatment	Total before and after treatments: 80	76	Standard value of points
No pain	0	0	0	0	0	0	11
mild or infrequent pain, normal activity	1	33	1	30	2	63	9
slight pain when walking, quickly disappears during rest	16	5	18	7	34	12	7
tolerable pain that limits activity	10	0	14	1	24	1	5
severe pain when walking, precluding any activity	10	0	5	0	15	0	3

severe pain even at night	3	0	1	0	4	0	1
pronounced and constant	0	0	1	0	1	0	0
Total	54(40)	52(38)	40	38	94	90	
Average score	5.1	9.7	5.5	8.5	5.3	8.6	11.3
M	5.1± 0.4	8.7± 0.86	5.5± 0.45	8.5± 0.79	5.3± 0.4	8.6± 0.82	
P	p<0.001		p<0.001		p<0.001		

As can be seen from Table 6.1, after treatment with ANFH, out of 94 patients, 63 patients had mild or rarely occurring pain, normal activity; 12 patients had minor pain during walking, which quickly disappeared during rest, 1 patient had tolerable pain, limiting activity. Severe nocturnal and severe and constant pain were not observed.

We also studied the degree of mobility of the hip joint in the observed patients after surgery (Table 5.2).

Table 5.2

The degree of mobility in patients with ANFH before and after neuroablation.

Degree of mobility	Hip joint mobility degree in points						
	I-II stages		III-IV stages		Total		Nor
	Before admission	After discharge	Before admission	After discharge	Before admission	After discharge	the mative value of points
flexion : more than 90	0	26	0	23	0	49	11

degrees, abduction: up to 30 degrees							
flexion: 80–90 degrees, abduction: less than 15 degrees	1	11	2	13	3	24	9
flexion: 60 – 80 degrees the patient can reach the foot	14	1	16	2	30	3	7
flexion: 40 – 60 degrees	15	0	10	0	25	0	5
flexion less than 40 degrees position	10	0	10	0	20	0	3
no movement, slight deformation	0	0	2	0	2	0	0
Total	54 (40)	52 (38)	40	38	94 (80)	90 (7 6)	
Average score	5.3	10 , 3	5.3	10.1	5.28	10.21	
M	5.3± 0.38	10.3± 0.68	5.3± 0.4	10.1± 0.61	5.28± 0.35	10.21 ± 0.65	
P	p <0.001		p <0.001		p <0.001		

Table 6.2 shows that after treatment with ANFH out of 94 patients the following was observed: 49 patients had flexion: more than 90 degrees, abduction: up to 30 degrees; 24 patients had flexion: 80 – 90 degrees, abduction: less than 15

degrees; 3 patients had flexion: 60 – 80 degrees, the patient could reach the foot. Flexion less than 40 degrees was a slight deformation and there was no ankylosis in the vicious position. When assessing the degree of hip joint mobility in patients after neuroablation RFA surgery, ankylosis was not detected, the functions of the hip joint improved, the range of motion of the joints increased.

The degree of restoration of the function of the affected joint was also judged by walking.

Table 5.3

Evaluation of gait status in patients with ANFH before and after neuroablation.

Walking condition	Walking condition assessment in points						
	I-II stages		III-IV stages		Total		Normative
					Before treatment	After treatment	the meaning of points
	Before treatment	After treatment	Before treatment	After treatment			
Norm	0	12	0	18	0	30	11
no cane, but slight limp	2	20	0	14	2	34	9
with a cane - can walk for a long	17	5	18	5	35	10	7

time, for a short time - without a cane and limping							
using one cane less than 1 hour; difficult - without a cane	15	1	12	1	27	2	4
only with the help of canes	3	0	9	0	12	0	3
only with the help of crutches	3	0	1	0	4	0	2
can't walk	0	0	0	0	0	0	0
Total	54(40)	52(38)	40	38	94(80)	90(76)	
Average score	5.3	9.24	5.1	9.55	5.19	9.39	
M	5.3	9.24	5, 08	9.55	5.19	9.39	
P	p<0.001		p<0.001		p<0.001		

Table 6.3 shows that after treatment with ANFH out of 94 patients the following was noted: 30 patients had normalized walking; 34 patients walked without a cane, but with a slight limp; 10 patients with a cane could walk for a long time, for a short time - without a cane and limping; 2 patients with the help of one

cane for less than 1 hour, with difficulty - without a cane. Patients walked only with crutches and could not walk was not noted.

The patients we observed before treatment had different severity of pain, mobility and walking. After treatment, pain in the joint gradually decreased and joint mobility, walking improved, which indicates the effectiveness of the neuroablation technique developed by us for ANFH. We assessed the results of treatment using neuroablation technique developed by us for ANFH in the near future according to the U. Oberg scale

Clinical example: Patient A. D., 70 years old, diagnosed with right-sided ANFH stage II . Before treatment, severe pain was noted even at night, flexion less than 40 degrees, walked only with the help of canes. After treatment, pain was noted during physical activity, disappeared during rest; flexion 80–90 degrees, abduction: less than 15 degrees: walked without a cane, but there was a slight limp. The average score was 6.5 before treatment, after treatment it increased to 9.6.

Thus, we assessed the treatment results according to the U. Obereg scale; good and very good results were considered when patients had no pain in the joints when walking and at rest, and we also took into account the increase in the amplitude of joint movements and normal walking. In patients with ANFH, we noted an improvement in the results after 1 month - in 85.8%, after 3 months - in 88.3%, after 6 months - in 82.0%, after 12 months - in 78.9%. We observed an increase in the period of remission of the disease for one year. Unsatisfactory in 2 (2.6%) patients. Who underwent hip endoprosthetics surgery, due to the presence of concomitant diseases.

§ 5.2 Technique of hip joint endoprosthetics.

We performed hip endoprosthetics with various endoprosthesis designs in 64 patients at various stages . All patients underwent total hip arthroplasty with various fixations.

Indications for cemented endoprosthetics:

1. The possibility of stable fixation of the endoprosthesis.

2. Preserved integrity of the acetabulum.

3. Young patients.

Indications for cement endoprosthetics:

1. The presence of a bone defect on the wall of the acetabulum.
2. BMD is very low with severe osteoporosis of the bones.
3. In the presence of protrusion of the bottom of the acetabulum.

Progress of hip arthroplasty surgery.

Preoperative clinical examination

Before considering total hip replacement surgery in any patient, a thorough history and physical examination are required. Patients should be asked about previous interventions and treatments. Previous joint replacements, arthroscopic procedures, or other hip surgeries should be considered as prior surgical incisions. In addition, a comprehensive medical evaluation should be performed, and all patients are advised to undergo a medical evaluation and risk stratification before consideration of total hip replacement surgery.

Other considerations include the patient’s body habitus, prior functional activity and postoperative expectation goals, the nature of the ANFH, and any previous history of hip trauma. The hip should be inspected for skin discoloration, wounds, or previous scars. Soft tissues should be examined for obvious atrophy, overall symmetry, and stability. Atypical leg discomfort and rest pain are common symptoms of peripheral vascular disease. While up to 50% of patients are considered asymptomatic at presentation, clinical suspicion of vascular disease may prompt preoperative consultation for vascular surgery.

The physical examination also includes an assessment of the mechanical axis and overall position of the limb. Before performing any hip surgery , it is imperative to exclude or at least consider the possibility of spinal pathology. Any leg length discrepancy should also be noted. It is also imperative to consider the influence of any of the following conditions in addition to the actual or apparent leg length discrepancy: hyperlordotic conditions of the spine, pelvic tilt, hip flexion contractures, the patient may not be able to stand upright. Preoperative range of motion should also be noted. Patients with end-stage ANFH most often present with a combination of hip adduction and flexion contractures. Any noticeable flexion contracture greater than 5 degrees and lack of flexion greater than 90-100 degrees should be documented. In addition, rotation is usually limited, especially with internal rotation. The neurovascular examination should also include a positive/negative straight leg raise test status.

Preoperative radiographs are recommended, including standing AP pelvis plus AP/lateral hip(s). On imaging, the hip is assessed for joint space narrowing, osteophytes, and the presence of subchondral sclerosis and/or degenerative cysts. Particular attention is paid to the planned center of rotation of the femur in relation to its own. The surgeon should also be aware of the planned cup medialization and the corresponding flare required to ensure proper medialization of the acetabular implant.

Under spinal anesthesia with the patient lying on the healthy side, after treating the skin of the lower limb with a betadine solution, we make an 8.0-10.0 cm long skin incision, Harding approach. We dissect the broad fascia of the thigh. We separate the middle gluteus muscle from the greater trochanter and mobilize it. Then we dissect the joint capsule in a " T " shape. Then, using two Hamann retractors and our "raspatory" instrument, we dislocate the head of the femur, then we file the neck of the femur at a level of 1 cm above the lesser trochanter and remove the head. We process the bottom of the acetabulum with cutters to the desired size. We install the cup at an angle of 45 degrees and an anteroposterior version of 10 degrees. Then, using reamers, we process the medullary canal of the femur. We install the leg. We check the range of motion and the presence of dislocation intraoperatively. Then we perform hemostasis step by step, wash with a betadine solution, install a drainage tube. Layered sutures on the wound. Aseptic dressing.

§ 5.3 Optimized methods of hip arthroplasty in aseptic necrosis of the femoral head.

In order to reduce the time of surgery and reduce postoperative complications, we have developed a medical surgical instrument - Raspator, for this utility model patent No. 2019 0224 WAS RECEIVED.

The utility model relates to surgical instruments used during hip joint endoprosthetics, during surgery for cutting the round ligament of the femoral head and can be used for dislocation of the femoral head.

During hip arthroplasty, many patients experience complications associated with a modified femoral head during dislocation of the femoral head: a sharply narrowed joint space, a thickened joint capsule, a deformed and fused femoral head with nearby soft tissues . It is difficult to dislocate the head without damaging nearby soft tissues and causing unwanted intraoperative bleeding. The solution to the problem of atraumatic dislocation of the femoral head during hip arthroplasty is relevant.

There are known raspators for exfoliating various tissues during surgical operations, straight, curved, oval, grooved and T-shaped (forceps for grasping and holding bones during surgical operations, having teeth to ensure a secure grip (Collection "Medical instruments, devices, apparatus and equipment". Central Bureau of Scientific and Technical Information, Moscow, 1975, 1-01-223).

However, the shape of the known raspators does not correspond to the anatomy of the femoral head , which makes it difficult to perform manipulations to dissect the round ligament of the femoral head and dislocate the femoral head with one instrument.

The shape of the working end of the known raspatory does not correspond to the shape of the femoral head or joint, making it difficult to perform in case of dislocation. Only the experience and skill of the surgeon can avoid a fracture in the middle third of the femur at the moment of dislocation of the head with external rotation of the femur and with excessive load on the bone. The raspatory requires the use of additional equipment.

The objective of the proposed device is to create a universal instrument that improves access to the operating area, eliminates possible trauma to soft tissues, and reduces bleeding around the hip joint. at the moment of dissection of the round ligament of the femoral head and during dislocation of the femoral head, reduce the duration of the operation .

To solve the tasks set, a raspatory is proposed, consisting of a handle and a working part, characterized in that the handle has a diameter of 30 mm and a length of 300 mm. hexagonal shape and is connected to the working part by a neck at an angle of 156 ^{o} , and the working part is made in the form of a grooved blade with a rounded end and sharpened edges.

A comparative analysis with the prototype shows that the claimed device differs from the known one in that the handle, with a diameter of 30 mm and a length of 300 mm, has hexagonal shape and is connected to the working part by a neck at an angle of 156 ^{o} , and the working part is made in the form of a grooved blade with a rounded end, sharpened at the edges. These distinctive features indicate the novelty of the technical solution.

Thus, the proposed device is novel and can be applied in practical medicine during hip joint endoprosthetics .

Cause and effect relationship:

The working part is made in the form of a grooved blade with a rounded end, sharpened at the edges, which provides a good view of the surgical field, allows for dissection of the round ligament of the femoral head and dislocation of the head without damaging nearby soft tissues and unwanted intraoperative bleeding in a short period of time.

handle (30 mm in diameter and 300 mm in length) allows it to be used as a lever, which reduces the resistance force of the femoral head during dislocation, and the hexagonal shape prevents it from slipping off the hand, increasing ease of use.

The connection of the neck at an angle of 156 ° with the working part provides a good view of the surgical field and increases ease of use.

Thus, the proposed time of hip arthroplasty universal device convenient, its implementation does not require the use of additional equipment . The aspator provides the ability to atraumatically excise the round ligament of the femoral head, as well as the possibility of dislocation of the femoral head

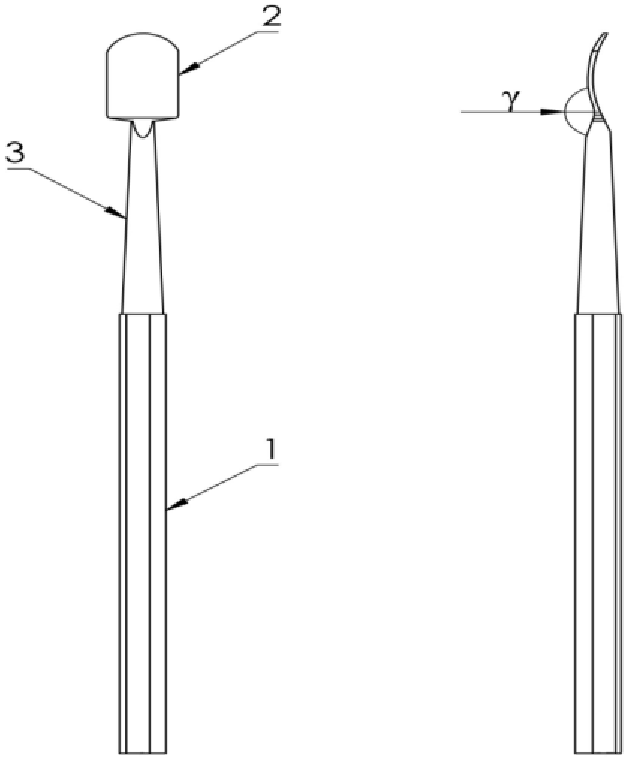


Fig.5.3. A Fig.5.3 . B

Figure 5.3 External appearance of the raspatory.

Fig. 5.3.A shows a raspatory for dissecting the round ligament of the femoral head and dislocation of the femoral head (top view), where: 1 is the handle, 2 is the working part, 3 is the neck; Fig . 5.3.B shows a raspatory, where 3 is the neck at an angle of γ=156 ° (side view).

Raspatory made of stainless steel grade (12X18H10), consists of a handle (1) and a working part (2). The handle (1) with a diameter of 30 mm and a length of 300 mm has hexagonal shape and is connected to the working part (2) by a neck (3) at an angle of $\gamma=156^{o}$. The working part (2) is made in the form of a grooved blade with a rounded end and sharpened edges.

The device is used as follows:

Under spinal anesthesia, with the patient lying on the healthy side, after treating the skin in the hip joint area with an antiseptic solution, a 7-10 cm long Harding skin incision is made. The broad fascia of the thigh is dissected . The medius gluteus muscle is separated from the greater trochanter. The joint capsule is removed. The working part (2) of the raspatory is inserted into the joint space between the head of the femur and the acetabulum (Fig. 5.3.A, Fig. 5.3.B). The raspatory is held with the surgeon's hand on a hexagonal handle (1) 30 mm in diameter and 300 mm long, connected to the working part (2) by a neck (3) at an angle of $\gamma = 156^{o}$. Using an oscillating saw, the neck is sawn and the head of the femur is removed. In the lower corner of the wound, the underdeveloped true acetabulum is isolated from the scars. A bed is formed in the acetabulum. The acetabular component is implanted and fixed to the pelvic bone. A standard stem of the endoprosthesis is installed in the medullary canal. The head of the femoral component is adjusted into the acetabular component. The amplitude of passive movements in the artificial hip joint is checked. The wound is sutured.

The raspatory is multifunctional, capable of simultaneously cutting the round ligament of the femoral head without damaging nearby tissues and atraumatically dislocating the femoral head. The length of the raspatory handle allows for increasing the leverage force and reducing the resistance force of the femoral head during dislocation from the acetabulum. The raspatory does not require additional instruments.

The device is simple, convenient and low-traumatic in use. It is recommended for widespread use in practice for dissection of the round ligament of the hip joint and dislocation of the femoral head. during hip replacement surgery,

During the operation, in order to facilitate the operations and reduce postoperative complications, we have improved the head of the joint endoprosthesis, primarily the hip joint "Spherical head of the hip joint endoprosthesis". UA 655449 u from 12.12.2011 , together with the State Institution "Institute of Pathology of the Spine and Joints named after prof. M.I. Sitenko of the Academy of Medical Sciences of Ukraine.

The utility model is used in orthopedics and concerns directly the improvement of the head of a joint endoprosthesis, primarily a hip joint. Spherical heads of a hip joint endoprosthesis are known, made either of carbon fiber (USSR patent No. 1813425, A61F 2/32, 1993), or of ceramics (AESCULAP company brochure, Germany, Huhendoprotesen-System. 2-4), or of a metal alloy (Altimed company brochure, Minsk, Belarus. - 1998). Each of the said heads contains a seat for the neck of the endoprosthesis stem in the form of a cut internal cone. In the known endoprosthesis head, the transition point from the inner wall to the smaller base of the cone is made along a ring line, which is a stress concentrator at this point.

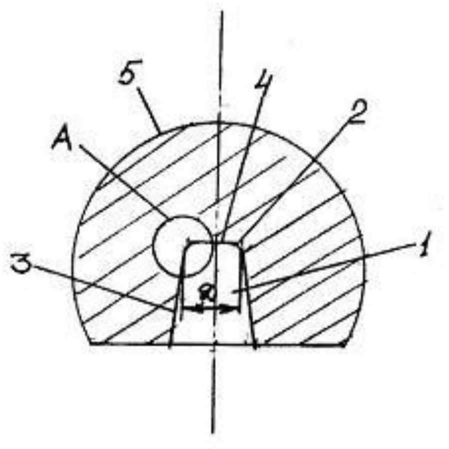
When the neck of the endoprosthesis is pressed into the seat of the head, significant radial and compressive forces are formed in the latter, and the presence of stress concentrators in the seat does not exclude the destruction of the head, or the appearance of micro- or macrocracks in its array, which are the cause of its destruction during operation. This drawback is especially evident in heads made of brittle materials - different types of ceramics, monocrystalline corundum, etc. This reduces the structural strength of the head, and therefore its operational reliability. The objective of this utility model is to create a spherical head of a joint endoprosthesis, primarily a hip joint, which does not provide for the formation of stress concentrators in its seat and, thus, contributes to an increase in its structural strength and operational reliability. In a spherical head of a joint endoprosthesis, primarily a hip joint, containing a seat for the neck of the endoprosthesis leg in the form of a cut internal cone, according to the utility model, the transition place from the inner wall to the smaller base. the cone is made rounded with a radius of curvature within the range of (0.08-0.15) D, where D is the diameter of the smaller base of the cone.

Making the transition point from the inner wall to the smaller base of the seat cone rounded with a curvature radius within the above limits does not form stress concentrators in this seat and thus contributes to an increase in the structural strength and operational reliability of the head. Similar technical solutions with similar features were not found during the patent information search. The proposed technical solution is new, clinically and industrially suitable.

The utility model is explained by the drawings, where Fig. 5.4 shows a schematic cross-section of the spherical head of the hip joint endoprosthesis; Fig. 5.5 shows view A , enlarged. The spherical head of the joint endoprosthesis contains a seat 1 under the neck of the endoprosthesis in the form of a cut-off internal cone, the transition point 2 from the inner wall 3 of which to the smaller base 4 is made rounded with a radius R of curvature within the range of (0.08-0.15) D, where D is the diameter of the smaller base of the cone. The head can be made of a metal alloy, for example, stainless steel, ceramics or monocrystalline corundum. On the outer surface of the sphere 5 of the head, if it is made of metal, a ceramic coating of a mixture of aluminum oxide Al2O3 and titanium dioxide T and O2 with a thickness of n=150-400 μm can be applied by one of the known methods (immersion, flame spraying, detonation, etc.). During the operation of such a head, the ceramic coating acts as a dielectric layer between it and the cup, as well as other parts of the endoprosthesis, and thus prevents the occurrence of a difference in electrical potential between them. Electrical oxidation of the outer surface of the sphere 5 does not occur, which has a positive effect on the absence of the occurrence of metallosis of the joint.

When manufacturing the head from ceramics or monocrystalline corundum, which are natural dielectrics, this also has a positive effect on its operational qualities. Making the transition place 2 from the inner wall 3 to the smaller base 4 rounded with a radius 3 R of curvature, which is within the range of (0.08-0.15) D, where D is the diameter of the smaller base of the cone, prevents the formation of stress concentrators in the mounting socket 1 and thus contributes to an increase in the structural strength and operational reliability of the head.

Making the radius R of curvature of the transition place more than 0.15 D does not improve any operational qualities of the head and at the same time negatively affects the technological costs of its manufacture. This head is suitable for endoprosthetics not only of the hip joint, but also of other joints of the body - shoulder, elbow, etc. Materialographic studies and modeling of the work of heads made of different materials - metal, ceramics and monocrystalline corundum, show the absence of any cracks, their destruction when pressing the neck of the endoprosthesis into the seat of the head, and taking into account the absence of a difference in electrical potentials between different parts of the endoprosthesis, an increase in its resistance to operation by 2.2-2.5 times was recorded. On this basis, it can be concluded that the operational reliability of such a spherical head increases more in volume.



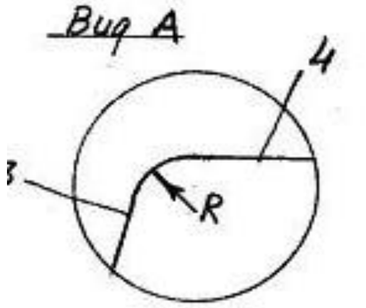


Fig.5.4 Fig.5.5

Thus, the spherical head of the joint endoprosthesis, primarily the hip joint, containing a seat for the neck of the endoprosthesis stem in the form of a cut-off internal cone, according to the utility model, the place of transition from the inner wall to the smaller base . the cone is made rounded. When pressing the neck of the endoprosthesis into the seat of the head, and taking into account the absence of a difference in electrical potentials between different parts of the endoprosthesis, an increase in its resistance to operation by 2.2-2.5 times was recorded. On this basis, it can be concluded that the operational reliability of such a spherical head increases more in volume.

We have developed a patent for a utility model "Method of hip joint endoprosthetics" UA 73531 U 09.25.2012

A method of hip joint endoprosthetics based on resection of the damaged part of the femoral neck together with the Adams arch in the lateral area, followed by removal of this part of the neck together with the head, preparation of the medullary canal in the femur and installation in the specified case . g of the endoprosthesis head - in the acetabulum. A horseshoe-shaped bone autograft is made from the removed portion of the patient's femoral neck, including the Adams arch, on the lower part of which a wedge-shaped one-sided protrusion is formed, the autograft is put on the endoprosthesis stem under its support flange, and the stem with the bone autograft is installed,

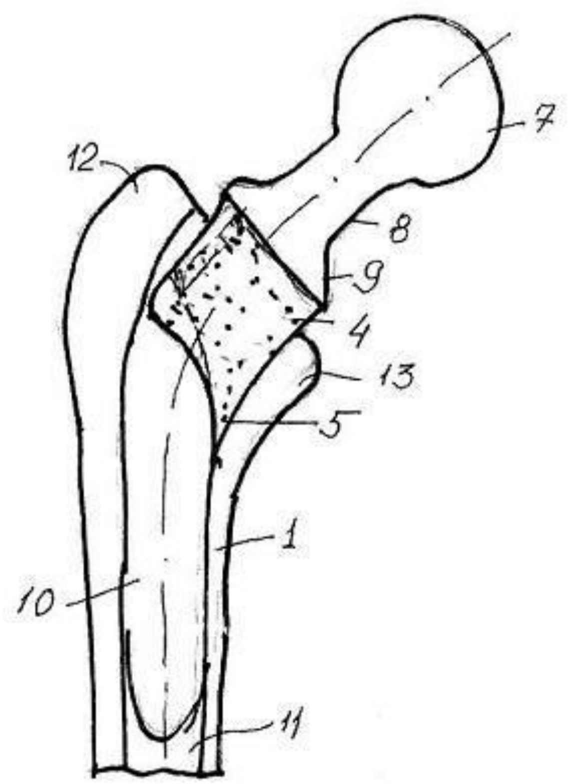


Fig.5.6

The utility model is related to orthopedics and is recommended for use treatment of fractures and defects of the proximal femur, namely, fractures of its neck together with the supporting anatomical part, the Adams arch. A method of hip joint endoprosthetics is known by resection and removal together with the head of the damaged neck of the joint and replacement of the said part of the joint with an artificial endoprosthesis, the stem of which is installed in the bone marrow canal of the femur prepared in advance for this purpose (patent RU No. 2051219). The disadvantage of this method of endoprosthetics is the low functional and operational stability of the location of the endoprosthesis stem in the femur, especially in cases of damage to the Adams arch. This causes early loosening of the endoprosthesis in the femur, which prevents the possibility of forming an integral biomechanical "bone-implant" system and leads to the need for repeated difficult surgical interventions.

This method of endoprosthetics has disadvantages, since the demineralized bone graft at the border of the "endoprosthesis material - bone tissue" of the recovery period, for bone formation. In essence and the achieved result, the method of hip joint endoprosthetics is based on the resection of the damaged part of the femoral neck in the lateral area with subsequent removal of this part of the neck together with the head, preparation of the bone marrow canal . femur and installation of the endoprosthesis stem with a support flange in the said channel, and the endoprosthesis head in the acetabulum (USSR Patent No. 1665865, A61B17/56, A61F2/32, 1991). The use of an endoprosthesis with a support flange, contacting the resected end of the femur, creates a certain stability of its location in the said bone, but in cases of fractures or defects of the Adams arc, the stability of the endoprosthesis is ensured only for a short period of its functioning.

During further operation of the endoprosthesis, due to friction of its support flange with the end of the femur, destruction of bone tissue of the proximal femur, its resorption and disruption of the stability of the endoprosthesis in the femur occur. In addition, osseointegration of bone tissue into the metal structure of the endoprosthesis support flange is not achieved, which also negatively affects the stability of the implant, especially during its long-term functioning. The task of this utility model is to create a method for hip joint endoprosthetics that promotes conditions for optimizing reparative processes and rapid osseointegration in the "endoprosthesis material - bone tissue" area, which improves conditions for stable fixation of the endoprosthesis in bone tissue for a longer period.

The problem is solved in this method of hip joint endoprosthetics based on resection of the damaged part of the femoral neck in the lateral area with subsequent removal of this part of the neck together with the head, preparation of the medullary canal in the femur and installation in the specified case. flange, and the head of the endoprosthesis - in the acetabulum, according to the utility model from the undamaged section of the patient's femoral neck, including the Adams arc, a horseshoe-shaped bone autograft is made, on the lower part of which a wedge-shaped one-sided protrusion is formed. support flange , and the installation of the endoprosthesis leg in the medullary canal of the femur is carried out together with the bone autograft, the wedge-shaped protrusion of which achieves its full contact with the femur in the area of the lesser trochanter, and the other part of the autograft - with the end of the specified bone in the area of the greater trochanter.

Manufacturing of a horseshoe-shaped autograft from an intact portion of the patient's femoral neck, including the Adams arc, the presence of a one-sided wedge-shaped protrusion on the said autograft, and placement of the autograft between the support flange of the endoprosthesis and the end of the femur . rapid osseointegration of the femoral tissue in the autograft, and, consequently, more stable fixation of the implant and a longer functioning period of the endoprosthesis in the patient's body. 1UA 73531 U Similar technical solutions with similar features were not found during the patent information search. The utility model is new and clinically applicable . Fig. 1 shows a photo reflection of the patient's radiograph before the operation (the radiograph shows a lateral fracture of the femoral neck with a section of the Adams arc (a)); Fig. 5.5 is a diagram of the formation of an autograft from an intact section of the patient's femoral neck; Fig. 5.6 is a view of the formed autograft; Fig. 5.7 is a diagram of hip joint endoprosthetics using a bone autograft; Fig . 5.7 shows a photographic print of an X-ray of the same patient after hip arthroplasty using the proposed surgical method, where the formed bone autograft (b) is fixed on the endoprosthesis stem, which was subsequently implanted into the medullary canal of the femur.

Hip joint endoprosthetics using the proposed method is performed as follows. With the patient in the left lateral position, the soft tissues are cut using the external anterolateral approach to the right hip joint, the proximal part of the femur 1 is isolated, the anterior group of muscles of the hip joint is cut off, the joint capsule, the damaged fragment of the head and neck are dissected.

From the lateral section of the removed part of the femur with a section of the Adams arc 3, a horseshoe-shaped autograft 4 is made, on the lower part of which a wedge-shaped one-sided protrusion 5 is formed, as well as a longitudinal groove 6. For implantation, an endoprosthesis is used that has an artificial head 7, a neck 8 with a support flange 9 and a leg 10. The autograft 4 is put on the side on which the longitudinal groove 6 is made, on the leg 8 of the endoprosthesis so that the autograft contacts the endoprosthesis. The leg 10 of the endoprosthesis is installed in the bone marrow canal 11 of the femur 1, which is prepared in advance, together with the bone autograft with the wedge-shaped protrusion 5 until the autograft is in full contact with the end of the femur in the area of the lesser trochanter. bones in the area of the greater trochanter 13. Such a complete and tight contact between the bone autograft 4 and the maternal bed of the femur 1 promotes the activation of osteoreparation processes and rapid fusion of the said bone fragments. In this case, the destroyed bone structures of the proximal femur are restored, thereby achieving stable fixation of the endoprosthesis in the bone tissue.

This in turn ensures earlier rehabilitation periods for patients in the postoperative period and stable fixation of the endoprosthesis and its functioning for a longer period. Observations of patients who underwent hip joint endoprosthetics according to the proposed method indicate an acceleration of the restoration of the operative and mobile function of the operated limb by an average of 1.3-1.45 times.

FORMULA OF A UTILITY MODEL

A method of hip joint endoprosthetics based on resection of the damaged part of the femoral neck together with the Adams arch in the lateral area, followed by removal of this part of the neck together with the head, preparation of the medullary canal in the femur and installation in the specified case . g of the endoprosthesis head - in the acetabulum, which is characterized in that a horseshoe-shaped bone autograft is made from the removed portion of the patient's femoral neck, including the Adams arch, on the lower part of which a wedge-shaped one-sided protrusion is formed, the autograft is put on the endoprosthesis leg under its support flange, and the installation of the bone knife is carried out together with the bone autograft, the wedge-shaped protrusion of which reaches its full contact with the femur in the area of the lesser trochanter, and the other part of the autograft - with the end of the said bone in the area of the greater trochanter.

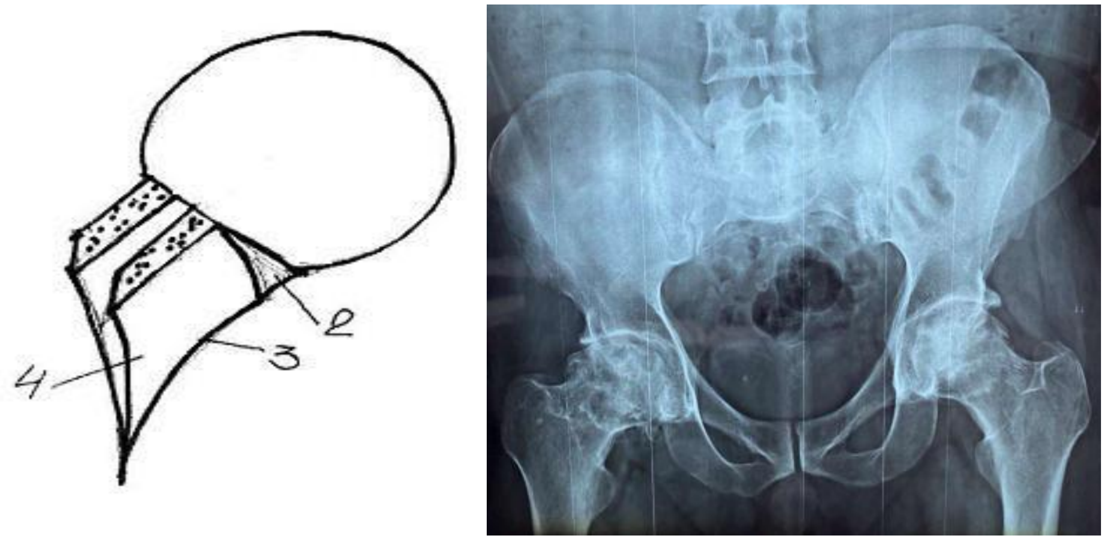


Fig. 5.7 Radiography and schematic picture of the prosthesis.

Thus, in the method of hip joint endoprosthetics based on resection of the damaged part of the femoral neck in the lateral area with subsequent removal of this part of the neck together with the head, preparation of the medullary canal in the femur and installation in the specified case. flange, and the head of the endoprosthesis - in the acetabulum, according to the utility model from the undamaged area of the patient's femoral neck, including the Adams arc, a horseshoe-shaped bone autograft is made, on the lower part of which a wedge-shaped one-sided protrusion is formed . with a port flange, and the installation of the endoprosthesis stem into the medullary canal of the femur is carried out together with a bone autograft, the wedge-shaped protrusion of which achieves its full contact with the femur in the area of the lesser trochanter, and the other part of the autograft - with the end of the said bone in the area of the greater trochanter.

ANFH is characterized by osteoporosis of bones. Such patients require installation of a cement stem of the endoprosthesis, but cement does not provide good osseointegration of the implant. We have proposed a method of endoprosthetic surgery for patients with osteoporosis of bones in ANFH. The essence of the method is that the proximal end of the implant is half cement and half bone so that there is good survival of the implant in the future. To do this, we form the removed neck of the femur to the shape of the proximal end of the implant, put a transplant on this end and, as it were, receive a collar of bone mass that will be osseointegrated in the future.

During the application of endoprosthetics, endoprostheses of various designs from foreign companies were used. The number of patients with cementless endoprostheses is given in Table 5.4.

Table 5.4

Distribution of patients operated with cementless endoprostheses by stages .

Friction pair	Cementless endoprostheses	Cemented endoprostheses	Total
Metal+polymer	14 (25 %)	3 (30%)	17 (19%)
Ceramics+polymer	36 (65%)	6 (700 %)	42 (2.5 %)
Ceramics+ceramics	5 (10%)		5 (5 6%)
Total:	55 (8 6 %)	9 (14 %)	64 (100%)

Of the 64, 55 (86%) patients underwent cementless endoprosthetics with different friction parameters: metal-polymer 14 (25%), ceramics+polymer 36 (65%), ceramics+ ceramics 5 (10%). Thus, of the 64 patients, most underwent operations with cementless endoprostheses (55 (86%)).

Table 5.5

Number of steps before and after endoprosthetic surgery in the main group.

In 10 days	In 20 days
5	8
4	7
3.6	6.6
4.4	4.8
5.2	5.8
3.9	4.8
6.1	6.3
6.3	8.6
4.4	5.8
5.1	7.3
4.7	6.6
5.8	8.8
4	7
3.6	6.6
4.9	6.2
5.4	6.8
3.7	4.9
6.4	6.9
5.5	7.7
M 4.84±01.15	M 6.66±0.21
P <0.001	

Table 5.6

Number of steps before and after endoprosthetics surgery in the control group.

In 10 days	In 20 days
5	5.2
4.4	4.9
3.6	3.9
4.4	4.8
4.9	5.1
3.9	4.1
6.1	6.3
6.3	6.5
4.4	4.6
5.1	5
5.7	5.8
5.8	6.2
4	7
3.6	3.6
Z	
M 4.8±0.19	M 5.21±024
P <0.001	

Conclusion to the chapter.

Recently, a modern new innovative method is used for severe pain syndrome against the background of ANFH (ablation). The method of radiofrequency neuroablation (RFA) is used to reduce pain in the hip joint and knee joint, also when it is impossible to replace the joint. Regardless of its cause in the area of the hip joint and, after the point application of electric current waves to the nerves, patients feel a significant reduction in pain in the pelvis and knee.

In order to reduce the time of surgery and reduce postoperative complications, we have developed a medical surgical instrument - Raspatory, used during hip arthroplasty to dissect the round ligament of the femoral head and dislocation of the femoral head . offered during hip replacement surgery universal device convenient, its implementation does not require the use of additional instruments . Its use for dissection of the round ligament of the femoral head and dislocation of the femoral head is atraumatic. During the operation, in order to facilitate operations and reduce postoperative complications, we have improved the head of the joint endoprosthesis, mainly the hip joint "Spherical head of the hip joint endoprosthesis"

ANFHB notes osteoporosis of bones. Such patients require installation of a cement leg of the endoprosthesis, but cement does not provide good osseointegration of the implant. We have proposed a method of endoprosthetic surgery in patients with osteoporosis of bones in ANFHB. The essence of the method is that the proximal end of the implant is half cement and half bone so that there is good survival of the implant in the future.

To do this, we shape the removed femoral neck to the shape of the proximal end of the implant, place the transplant on this end, and, as it were, obtain a collar of bone mass that will osseointegrate in the future.

CHAPTER VI . Evaluation of treatment results in patients with aseptic necrosis of the femoral head.

§ 6.1 Comparative analysis of isolated results of surgical treatment.

We studied the quality of life of patients developed scale . The patients were of working age from 20 to 65 years. In this system, 6 clinical parameters were used on a 5-point scale, the clinical result was assessed by analyzing the sum of points. The developed algorithm for diagnosing ANFH for assessing the quality of life was certified by the Intellectual Property Agency No. DGU 2021 1977 of 2021.

According to the quality of life assessment developed by us, good results were in the range from 15 to 22 points, satisfactory - from 8 to 14; unsatisfactory was assessed by a sum from 0 to 7 points. Having summed up the received points, we assessed the effectiveness of the treatment and presented them as a percentage, which reflected the difference between the increase in the point score received after the treatment. We took the initial state of the patient as 100%. After the operation, an increase in the point score of up to 30% of the initial point scores of the patient before the surgical intervention was noted (Table 6.1)

Table 6.1

Criteria for assessing the quality of life of patients with ANFH after endoprosthetics.

Evaluation criteria	Before treatment (n- 64) patients		After treatment, one month later. (n- 64) patients	
	Main	Conte	Main	Counter
Pain	1	1	2.5	2
Function	1.5	1.5	2.5	2
Emotional	1.5	1	1.5	1.5
The need for rehabilitation and support equipment (orthoses, cane)	1	1	2.5	2.5

Ability to walk/perform an action with the lower limb	1.5	1.5	2.5	2
Impaired gait/ability to lift and carry heavy objects.	1.5	1	2.5	2
Total points	8	7	14	12
M	8±0.008	7±0.08	1 4 ±0.17	12±0.17
P	p <0.001		p <0.001	

In order to study the treatment results, comparative immediate treatment results were conducted in patients with ANFH before and 1 month after surgical treatment. Comparative treatment results in patients with ANFH before and 1 month after surgical treatment (Table 6.1).

Table 6.1 shows that before the operation, patients with ANFH had pain - 3 points in the main group, 3.5 points in the control group. After the operation, after one month, it became 3.5 points in the main group and 3 points in the control group.

Before the operation, patients had a mobility impairment of varying severity; after the operation, the impairment was restored; before the operation, 1.5 points were noted in the main group and 1.5 points in the control group. After the operation, after one month, it became 2.5 points in the main group and 2 points in the control group.

Before the operation, patients had emotional perception in the main group it was 2.5 points and in the control group it was also 3 points. After the operation, after one month, it became 2.5 points in the main group and 1.5 points in the control group. Before the operation, patients needed rehabilitation and support means (orthoses, cane) in the main group it was 1.5 points and in the control group it was also 1.0 points. After the operation, after one month, it became 2.5 points in the main group and 2.5 points in the control group. Before the operation, patients had little ability to walk, perform actions with the upper limb before the operation in the main group it was 1.5 points and in the control group it was also 1.5 points. After the operation, after one month, it became 2.5 points in the main group and 2 points in the control group. Before the operation, patients had the ability to lift and carry weights before the operation in the main group it was 1.5 points and in the control group it was also 1.0 points. After the operation, after one month, it became 2.5 points in the main group and 2 points in the control group. The average score before treatment was 8 in the main group and 7 in the control group. After treatment, the main group had 14 points and the control group had 12 points. The presence of constant pain was the main indication for After the operation in both groups, after surgical treatment the pain decreased most in the main group compared to the control group, which shows the good effectiveness of surgical treatment of hip joint.

We present comparative results of treatment in patients with ANFH after treatment after 3.6 months and one to two years (Table 6.2).

Table 6.2

Comparative treatment results in patients with ANFH after surgical treatment

Evaluation criteria	Before and after endoprosthetics 64 patients							
	3 months		6 month		1 year		2 years	
	Main	Conte	Main	Conte	Main	Conte	Main	Conte
Pain	3	2.5	3.5	3	4	3	4	4
Function	3	2.5	4	3	4	3	4	4
Emotional	3	3	3	3	3	4	4	3
The need for rehabilitation and support equipment	3	3	3.5	3	4	4	4	4

(orthoses, cane)								
Ability to walk/perform an action with the upper limb	2.5	2	3	3	3	2.5	3	3
Impaired gait/ability to lift and carry heavy objects.	3	2	3	2	3	2.5	3	3
Total points	17.5	15	20	17	21	19	22	21
M	17.5± 00.8	15± 0.08	20± 0.16	17± 0.17	21± 0.17	19± 0.25	22± 0.17	21± 0.16
P	p <0.001		p <0.001		p <0.001		p <0.001	

Table 6.2 shows that in patients after surgery, pain was noted in the main group: after 3 months - 3, 6 months - 3.5, 1 year - 4 and 2 years - 4 points. In the control group: after 3 months - 2.5, 6 months - 3.0, 1 year - 3 and 2 years - 4 points.

After the operation, the functional impairment was observed in the main group: after 3 months – 3, 6 months – 3.5, 1 year – 4 and 2 years – 4 points. In the control group: after 3 months – 2.5, 6 months – 3.0, 1 year – 3 and 2 years – 4 points.

After the operation, patients had an emotional perception in the main group: after 3 months - 3, 6 months - 3.0, 1 year - 3 and 2 years - 4 points. In the control group: after 3 months - 3.0, 6 months - 3.0, 1 year - 4 and 2 years - 3 points.

After the operation, patients showed a need for rehabilitation and support means (orthoses, cane) in the main group: after 3 months - 3.6 months - 3.5, 1 year - 4 and 2 years - 4 points. In the control group: after 3 months - 3.0, 6 months - 3.0, 1 year - 4 and 2 years - 4 points.

After the operation, patients had the ability to walk, perform actions with the upper limb, emotional perception in the main group: after 3 months - 2.5, 6 months - 3.0, 1 year - 3 and 2 years - 3 points. In the control group: after 3 months - 2.0, 6 months - 3.0, 1 year - 2.5 and 2 years - 3 points.

After the operation, patients had gait disturbance, the ability to lift and carry heavy objects in the main group: after 3 months - 2.5, 6 months - 3.0, 1 year - 3 and 2 years - 3 points. In the control group: after 3 months - 2.0, 6 months - 2.0, 1 year - 2.5 and 2 years - 3 points.

The average score before treatment in the main group: after 3 months - 17, 6 months - 20.0, 1 year - 21 and 2 years - 22 points. In the control group: after 3 months - 15.0 , 6 months - 17, 1 year - 19 and 2 years - 21 points. From these data we can say that in the postoperative period, after 6 and 12 months, patients show improvement in treatment results: reduced pain, deformation, increased range of motion of the joints and improved limb function.

Table 6.3

Results according to the scale we developed

	Main		Control		Total	
Rating on a scale	Abs	%	abs	%	abs	%
Good	42	95	10	50	52	82
Satisfactory	1	2.5	5	25	6	9
Unsatisfactory	1	2.50	5	25	6	9
Total	44	100	20	100	64	100
M	44±0.93		20±0.25			
P	p <0.001		p <0.001		p <0.001	

Table 6.3 shows that in patients with ANFH, good results were obtained in the main group in 42 (95 %), in the control group in 10 (50 %). Satisfactory in the main

group in 1 (2.5 %), in the control group in 5 (25 %). Unsatisfactory in the main group in 1 (2.5 %), in the control group in 5 (25 %).

We present a clinical example of a patient from our observations: B-oy B.S. I/ B No. 303/67 , 1986 with a diagnosis of: Bilateral ANFH stage IV . Before surgery , pain, deformation and walking summed up to 12 points, after surgery it became 18 points (Figure 6.1.A , B , C).

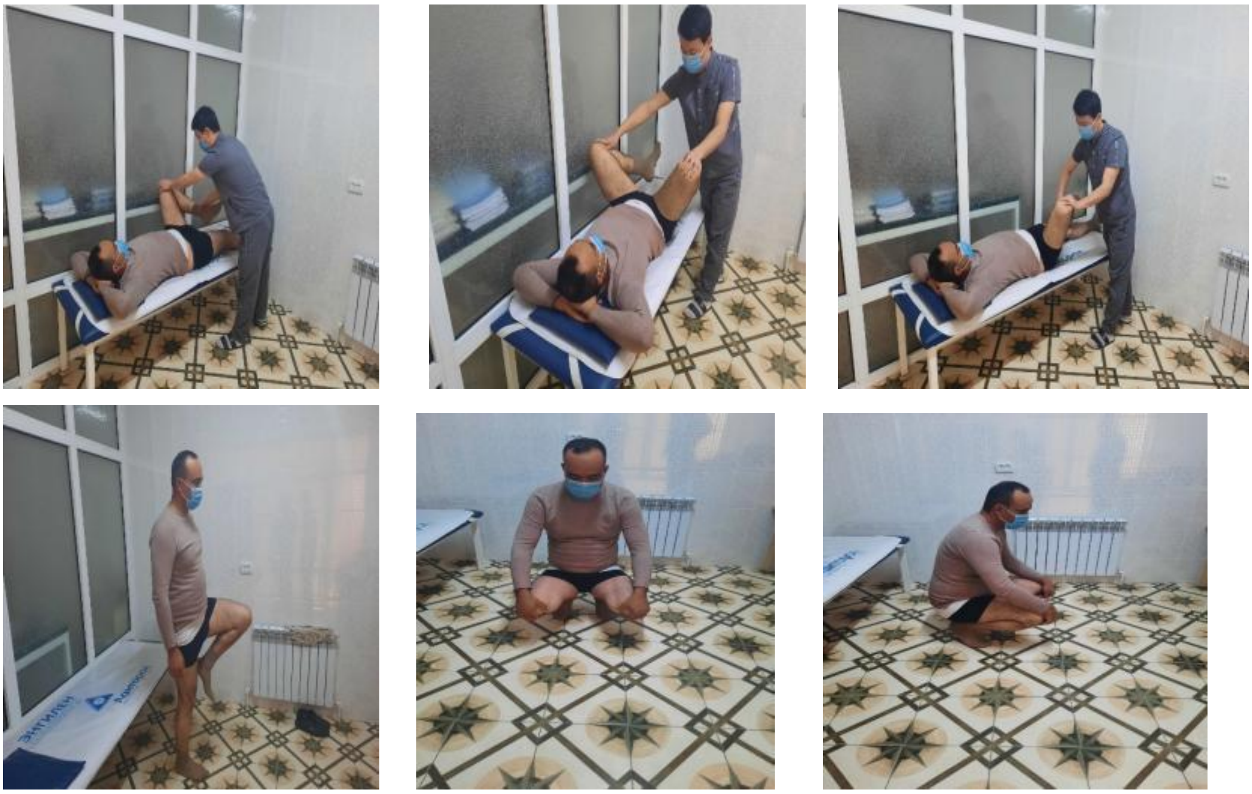


Figure 6.1.A Patient B.S. 1986 No. IB 303/67 with ANHB IV degrees. Condition after surgery for endoprosthetics of both hip joints and joint function.

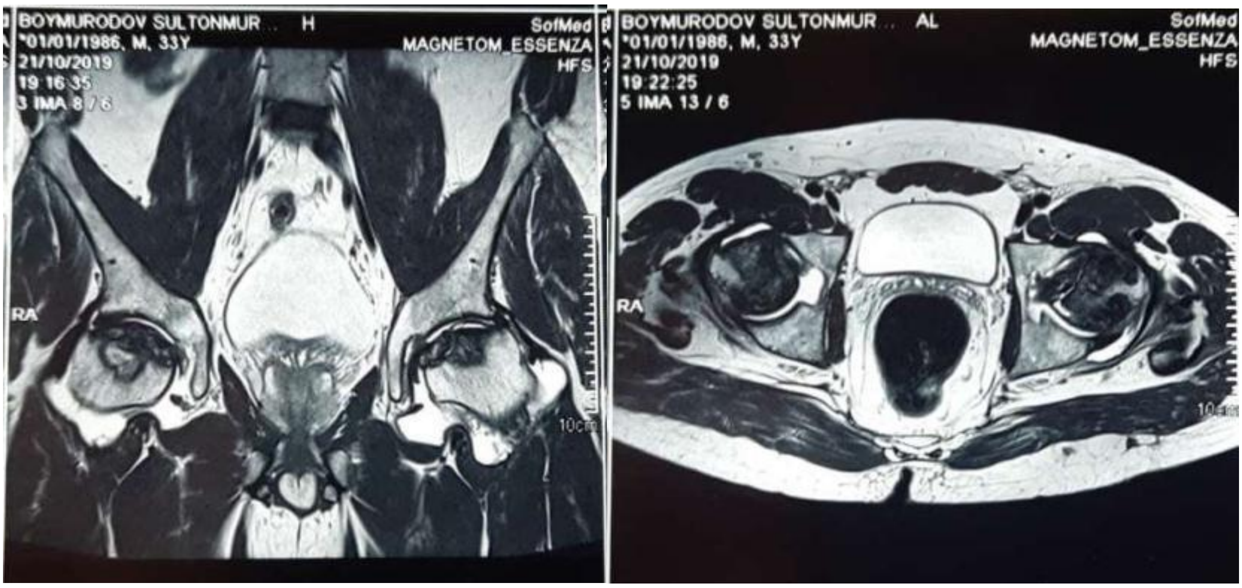


Figure 6.1.B. Patient B.S. 1986 No. IB 303/67 with ANHBK IV degrees. MRI before surgery.

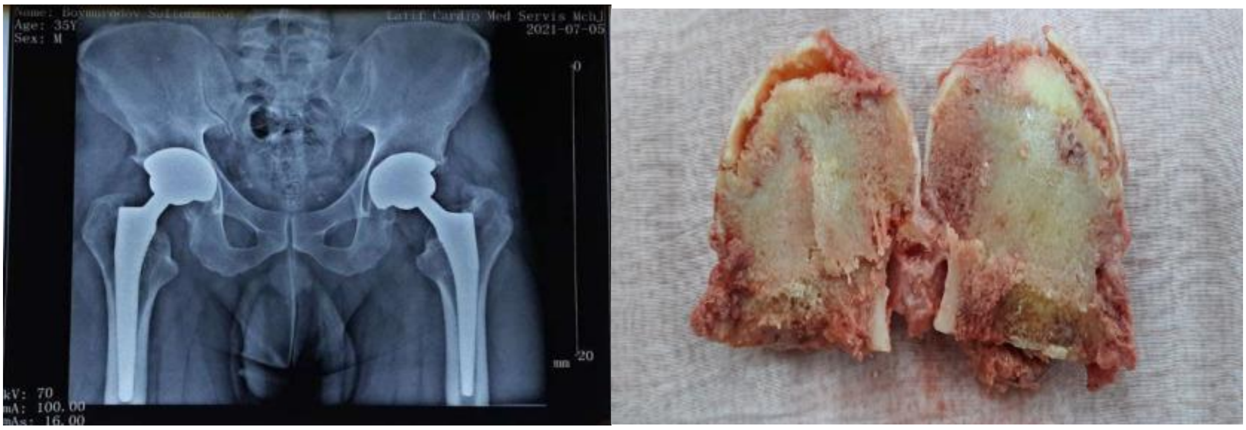


Figure 6.1.C. Patient B.S. 1986 No. IB 303/67 with aseptic necrosis of the head of both femurs IV degrees. X-ray of the patient after endoprosthetics surgery and macropreparation (femoral head).

The patient showed improvement in treatment results after 6 and 12 months of surgery: pain reduction, increased range of motion of joints, and improved limb function . as well as the patient's quality of life.

We present a clinical example from our observations: B- oy Kh.Sh. I/ B No. 130/30 , 1975 with the diagnosis: Bilateral ANFH stage IV . Before surgical treatment , pain, deformation and walking summed up to 11 points, after surgical treatment it became 17 points (Fig . 6.2. A , B , C).

Figure 6.2.A. Patient Sh.R. 1975 No. IB 456/19 with ANHBK IV degrees. Radiography and MRI before surgery.

Figure 6.2.B. Patient Sh.R. 1975 No. IB 456/19 with ANHBK IV degrees. Radiography and macropreparation (head of the femur) after endoprosthetics of both hip joints.

Figure 6.2.C. Patient Sh.R. 1975 No. IB 456/19 with aseptic necrosis of the head of both femurs IV degrees. Condition after surgery for endoprosthetics of both hip joints and joint function.

Thus, when studying the results of treatment of patients with ANFH, good results were obtained in the main group in 42 (95 %), in the control group 10 (50 %). Satisfactory in the main group in 1 (2.5 %), in the control group 5 (25 %) . Unsatisfactory in the main group in 1 (2.5 %), in the control group 5 (25 %).

According to the comparison of the main and control groups, the results of treatment after endoprosthetics in the main group are good 95 %, in the control group 50 %, these data show the effectiveness of surgical treatment in the main group.

Here is a clinical example. Patient K.A., 71 years old, I.B. 510/43 , diagnosed with stage III ANFH on the right. Before treatment, he had severe pain, limited activity, hip extension and flexion within 50-85 degrees, the patient walked with one cane and could not reach his foot. After treatment, there was minor pain, the patient became active and could also flex the hip joint by more than 90 degrees, abduction: up to 30 degrees; walked normally. The average score was 7.6 before treatment, and 9.8 after treatment. (Figure 6.3 . A , B).

A. Before treatment

B. After treatment

Figure 6.3.A ,B . Patient N.M. born in 1978. No. IB 676/15 with aseptic necrosis of the head of both femurs IV degrees. Radiography before and after surgery for right hip replacement.

The assessment was considered good and excellent when the patient did not have pain during walking and at rest, the range of motion in the hip joint increased, and muscle tension disappeared. Good and satisfactory results were noted in 58 (91%) patients after surgery. Unsatisfactory results were observed in 6 (9%) patients , of which 5 patients were in the control group.

The results of neuroablation in the dynamics of subjective pain sensations before and after treatment, reflected in the results of the questionnaire on VAS , as well as the assessment of functional limitations on HN S are presented in Table 6.4

Table 6.4

Dynamics of subjective indicators according to VAS and HHS index.

Stages of observation	YOURS, cm	HHS , score
	Group 1	Group 1
Before treatment	7.7 <>0.1 5	21.6 <>0.67
In 14 days	5.1 <>0.21	47.4 <>1, 21
In 1 month	4.4 <>0.25	51.3 <>1.44
In 3 months	3.4 <>0.27	55.7 <> 2 ,03
In 6 months	3.1 <>0.29	55.9 <>2.67
In 12 months	2.7 <>0.31	56.9 <>2.98

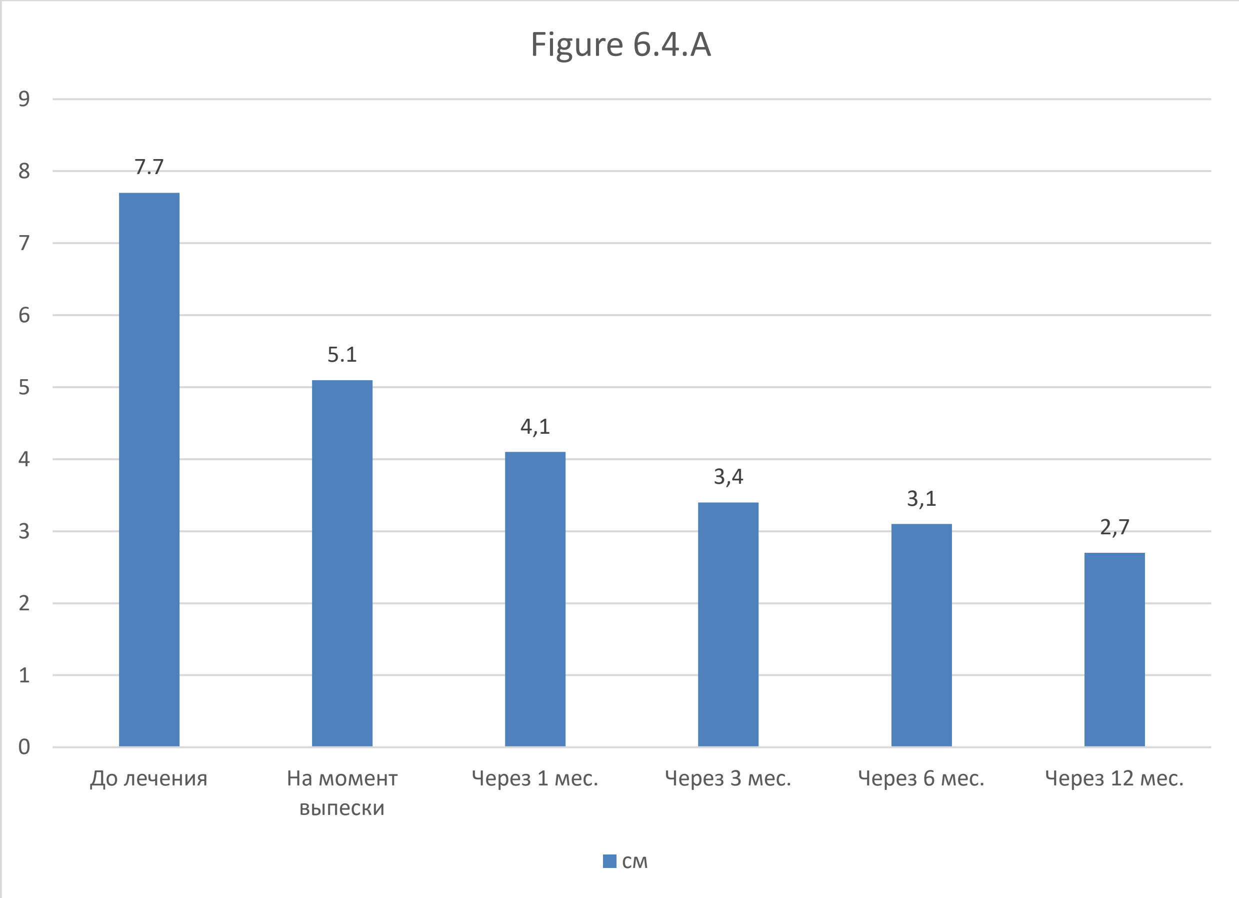


Figure 6.4.A
9
8
7
6
5
4
3
2
1
0
7.7
5.1
4,1
3,4
3,1
2,7
До лечения
На момент выпески
Через 1 мес.
Через 3 мес.
Через 6 мес.
Через 12 мес.
см

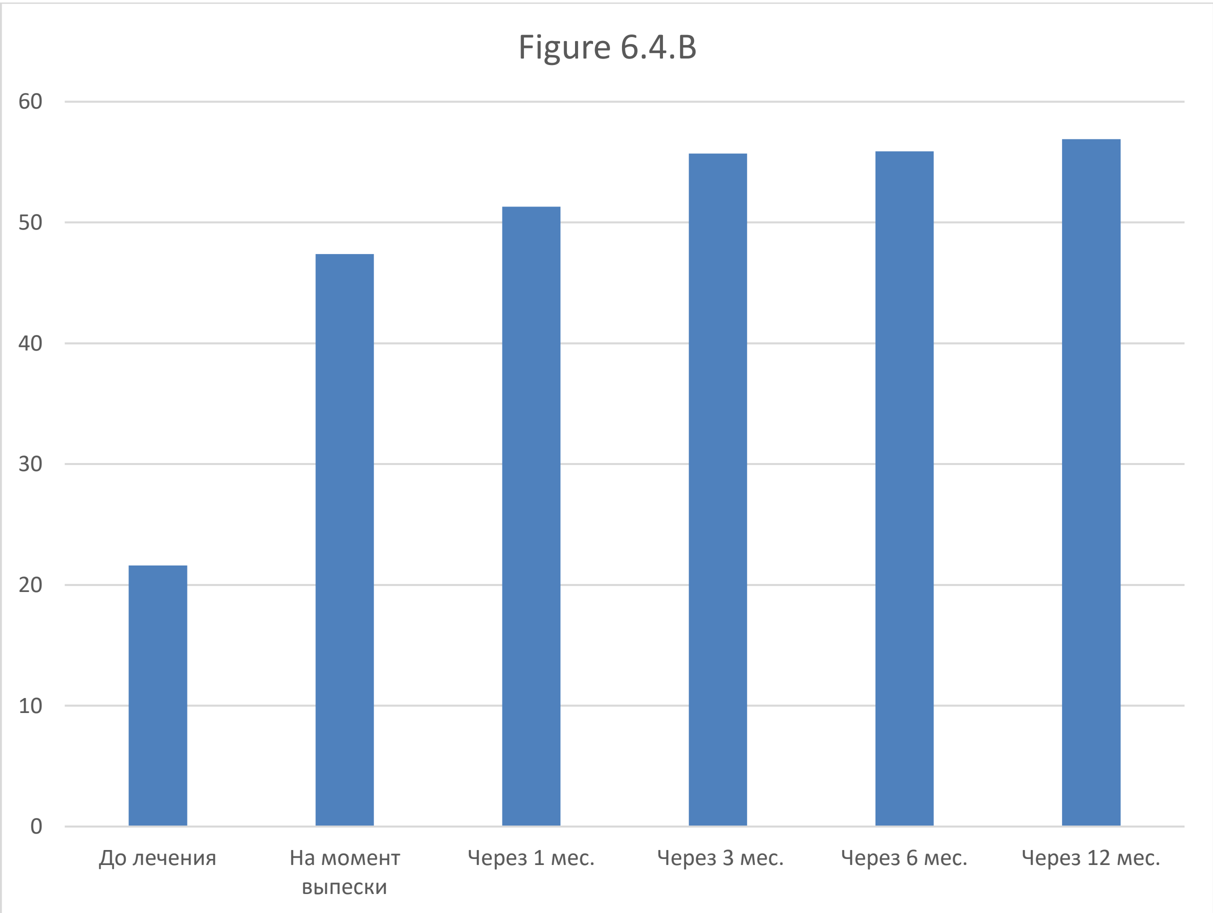


Figure 6.4.B
60
50
40
30
20
10
0
До лечения
На момент выпески
Через 1 мес.
Через 3 мес.
Через 6 мес.
Через 12 мес.

Figure 6.4.A ,B . Dynamics of subjective indicators according to VAS and HHS index

Thus, the assessment of the treatment results after the use of neuroablation was obtained by VAS, cm and HHS , the score before treatment was 7.7 <> 0.15 and 21.6 <> 0.67, after treatment after 3 months it became 3.4 <> 0.27 and 55.7 <> 2.03, after 6 months 3.1 < > 0.29 and 55.9 <> 2.67, and also after 12 months 2.7 <> 0.31 and 56.9 <> 2.98. These indicators indicate the effectiveness of this method.

§ 6.2 Stages of rehabilitation of patients after endoprosthetics.

Rehabilitation of patients after endoprosthetics for avascular necrosis of the femoral head involves the following main points: One of them is the return of patients to work. The second is the creation of optimal conditions for his active participation in the life of society, as well as improving the quality of life of patients. Medical rehabilitation of patients with ANFH included the following stages: inpatient, outpatient and polyclinic, sanatorium and resort. At the stage of inpatient rehabilitation included preoperative rehabilitation and surgical treatment.

We have carried out rehabilitation of all 64 patients with total endoprosthetics from 2015 to 2021, operated on for avascular necrosis of the femoral head. Hip endoprosthetics was divided into two stages: Of these, from the moment of surgery to 3 weeks is the early stage. From 3 weeks to 10 weeks is the late stage. During this time, it is necessary to productively perform tasks and exercises for rehabilitation after EP of the hip joint by the surgeon and rehabilitation specialist. At the sanatorium-resort stage, patients received exercise therapy and physiotherapy every year for 3 years in sanatorium - resort conditions.

It is especially important to conduct a preoperative assessment of the condition of patients with hip joint movements, shortening, and concomitant diseases , as they are the starting point for comparing and taking into account the results of surgical treatment. Before surgery, patients should be familiarized with the operation and its possible complications . how to conduct exercise therapy of the hip joint after surgery. The preoperative period lasts 3-4 days. The period of the operation. After the operation, the patient is in the intensive care unit for 24 hours and receives: antibacterial drugs (antibiotics), in order to prevent the development of infection; anticoagulant drugs from venous thrombus formation .

And also against pain, prevention of inflammation of non-steroidal anti-inflammatory drugs; to accelerate the regeneration of bone and muscle structures of protein and calcium supplements.

After the surgical intervention, the treatment and recovery period began for both groups of patients, which lasted for 2-3 weeks . In the main group, special therapeutic exercises for the rehabilitation of patients developed by us were used and were carried out in a gentle mode. In the control group, patients performed therapeutic physical training independently without an instructor.

Early stage - after EP TBS, patients are in the intensive care unit for 24 hours. The department monitors the main functionally significant indicators of the body's condition: blood pressure, heart rate, breathing, etc. If necessary, blood and blood substitutes are transfused. In order to prevent congestion in the lungs, breathing exercises are performed.

Immediately after the operation uses compression cuffs. Conducting rehabilitation measures strengthens the outcome of surgical intervention. Surgeons and all authors do not recommend during the performance of physical exercises bringing the limb with internal rotation of the hip , in order to prevent dislocation of the endoprosthesis head. Both groups main and control group after surgery.

Table.6.5

List of special exercise therapy exercises after surgery for ANFH (starting position - lying on your back).

Exercise content	Dosage	Days	Pace	Conditions of execution

Flexion and extension of the toes and ankle joints with tension in the calf muscles	5-10 times	1-2 day	Slow	Breathing is free
Flexion and extension of the toes and ankle joints with tension of the calf muscles. Flexion and extension, abduction and adduction of the fingers . Toning massage of the palmar surfaces of the hands for 1 minute. Nishi exercises "closing the palms"	10 – 15 times	3-4 day	Slow	Breathing is free
Alternate lifting of straight legs and tilting them towards oneself. Passive development of the operated limb was carried out to facilitate flexion. Gymnastics for the fingers of the hand. Nishi's exercises "closing the palms"	10-15 times	5-6 day	Average	When raising, exhale; when lowering, inhale.
Simultaneous raising of straight legs, push-ups towards oneself. Straight leg abduction, flexion and extension of the knee joint of the operated limb. Finger exercises. Nishi exercises "palm-joining" exercises with visual control, three-legged walking.	12-15 times	Day 8-9	Slow	Breathing is free

Raising the operated straight leg , with the tip towards you. Active flexion and extension of the operated limb in the knee joint were performed. Exercises for the hand	10 – 15 times	10-12 day	Average	Breathing is free
Raising the operated straight leg, pushing it towards you. Abduction of the straight leg, flexion and extension of the knee joint of the operated limb. Gymnastics for the fingers of the hand. Nishi's exercises "closing the palms" Nishi's exercises "closing the palms"	12 – 15 times	Day 14-15	Average	Breathing is free

After the operation, the operated limb was given abduction by 20 °using a bolster between the legs. In order to prevent thrombosis of the vessels of the lower limb after the operation, they were immediately bandaged with an elastic bandage. The next day, depending on the volume of blood loss, if necessary, intravenous infusion of blood substitutes is carried out. On the same day, depending on the patient's condition, they were allowed to sit up in bed, and the head ends of the functional bed were raised twice for 15 minutes. The patients performed these exercises with the abduction of the operated limb by 20. °The patient was allowed to lie on the healthy side with a pillow or bolster between the legs. On the 3rd-4th day after constant elastic bandaging of the legs, they were allowed to sit up in bed. Patients walked with outside help on crutches or walkers.

On the 4th-5th day, patients began to do exercise therapy with the help of an instructor and walked around the ward with crutches or walkers without putting any load on the operated limb.

On the 6th-7th day, patients were allowed to walk on crutches or a walker with a slight load on the operated limb. On the 8th-9th day, patients walked along the corridor up to 200 meters with a slight load. On the 10th-12th day, patients climbed the stairs once a day; later, the load was increased ; they were allowed to climb one flight of stairs. On the 14th-15th day, the stitches from the surgical wound were removed. Patients were taught to walk with a support device and self-care skills.

In order to evaluate the effectiveness of the method developed by us, a walking test was conducted at speed, as well as on coordination. With this method, an asymmetry of the operated and non-operated limb is noted in the speed of the steps taken.

The method we developed was performed before and after the operation on the 14th-15th day. This method took into account the number of movements of patients in 15 seconds. This method makes it possible to determine the state of various muscle groups during movement.

Table.6.6

Test evaluation. The interval covered by patients 15 seconds before surgery.

Main group 12 people	Control group 12 people
2.1	2.8
2.5	3.5
4.8	3.3
4	3.83
3.5	3.2
3.2	4.5
2.7	3.6
3.5	2.5
2.8	3.35

3.7	3.1
2.75	3.2
3.1	3.2
M = 3.3 ±0.1	M = 3, 6 ±0,2

Table.6.7

Test evaluation. The interval covered by patients in 15 seconds after surgery.

Main group 12 people	Control group 12 people
5.01	4.85
5	3.5
5.2	4.36
4.9	4.83
4.2	4.2
5.1	3.5
4.7	4.6
4.95	4.5
4.83	4.35
5.75	3.8
4.76	4.9
4.9	4.9
M = 4.8 ±0.1 2	M = 4.2 ±0.1 1

This test shows the condition of the muscular system. It also allows to judge the performance of the periarticular muscles, and provides the opportunity to control the healthy and operated limb in comparison.

Table.6.8

Speed test assessment (number of movements in 15 seconds).

Group	Research time	Unoperated limb			Operated limb		
		Abduction Legs	walking forward	walking backwards	Abduction Legs	walking forward	walking backwards
Counter.	Preoperative period	9.3	9.5	9.5	9.9	9.8	9.7
		9.53			9.8		
	4-5 day	9.2	9.9	8.9	8.6	8.5	8.2
		9.5			8.5		
	15th day	9.8	9.2	9.8	8.9	8.5	8.5
		9.5			8.6		
Basics.	Preoperative period	10.8	9.7	9.5	10.8	9.5	9.8
		9.8			9.9		
	4-5 days	11.9	11.0	11.5	8.6	8.8	9.1
		11.5			8.9		
	15th day	11.2	11.6	11.0	12, 2	13.1	12.0
		11.8			12.5		

The table shows that before and after the operation, when performing a walking test at a speed of 15 seconds, a difference in movements was noted in a slight increase in the abduction of the operated leg compared to the healthy one. The step test changed, on the 15th day this indicator on the operated leg in the main group was 12.5 m in 15 seconds , and in the control group the patient walked 8.6 m, which is worse than in the main group. According to our method for assessing the step test, positive results were on the part of the operated leg, which provides opportunities for the performance of the muscles of the lower extremities and prevents dislocation of the endoprosthesis. The step test showed that the treatment results obtained are better than in the control group.

Conclusion to the chapter.

Remote treatment results after neuroablation were studied using the U. Obereg scale. Good and very good results were considered when patients had no pain in the joints when walking and at rest. We also took into account the increase in the range of motion of the joints and normal walking. In patients with ANFH, we noted an improvement in results after 1 month - in 85.8%, after 3 months - in 88.3%, after 6 months - in 82.0%, after 12 months - in 78.9%. We observed an increase in the period of remission of the disease for one year. Unsatisfactory in 2 (2.6%) patients. Who underwent hip endoprosthetics surgery, due to the presence of concomitant diseases.

Remote results of treatment after endoprosthetics were studied for the quality of life of patients using a scale developed by us. According to the quality of life assessment developed by us, good results were in the range from 15 to 22 points, satisfactory - from 8 to 14; unsatisfactory was assessed by a sum from 0 to 7 points.

In the main group, good results were obtained in 45 (82.6%), in the control group 40 (73%). Satisfactory in the main group in 9 (16.4%), in the control group 13 (24%). Unsatisfactory in the main group in 1 (1%), in the control group 2 (3%). According to the comparison of the main and control groups, the results of treatment after endoprosthetics in the main group are good 82.6%, in the control group 73%, these data show the effectiveness of surgical treatment in the main group.

Medical rehabilitation of patients with ANFH included the following stages: inpatient, outpatient and polyclinic, sanatorium and resort. The inpatient rehabilitation stage included preoperative rehabilitation and surgical treatment.

After hip replacement, it was divided into two stages: From the moment of surgery to 3 weeks is the early stage. From 3 weeks to 10 weeks is the late stage . before the operation after the operation when performing a walking test at a speed of 15 seconds, a difference in movements was noted in a slight increase in the abduction of the operated leg compared to the healthy one. The step test changed, on the 15th day this indicator on the operated leg in the main group was 12.5 m in

15 seconds , and in the control group the patient walked 8.6 m, which is worse than in the main group. According to our method for assessing the step test, positive results were on the part of the operated leg, which provides opportunities for the performance of the muscles of the lower extremities and prevents dislocation of the endoprosthesis. The step test showed that the results of treatment are better than in the control group.

Conclusion.

Aseptic necrosis of the femoral head is a progressive pathological process that primarily affects people under 40 years of age. Osteonecrosis of the femoral head is caused by insufficient blood supply, which leads to the death of osteocytes. This subsequently progresses to collapse of the femoral head and severe destruction of the joint.

Without timely and effective treatment, it causes avascular necrosis and, ultimately, deforms the bone. The consequence of this is a violation of the function of the hip joint and irreversible disability [4; 5-10-s., 10; 125-128-s.]. Many authors have proven that early diagnosis, complex and specific treatment of ANFH depends on the stage of the disease, which are the key to successful treatment and help reduce complications.

As studies of recent years show, ANFH is a polyetiological disease, with general and local factors playing a major role: previous trauma, alcohol intoxication and taking steroid drug therapy.

Other authors believe that ANHB can be idiopathic and constitutional, genetic, i.e. overload with violence on damage to the hip against the background of a genetically determined defect, as well as congenital anatomical and functional insufficiency of the hip joint.

Currently, numerous instrumental research methods have been developed and implemented in healthcare practice for diagnosing patients with ANFH.

The authors noted that radiography of the hip joint makes it possible to determine the area of bone tissue compaction, as well as changes in the joint space and the presence of enlightenment , as well as changes in the structure of the affected part of the femoral head.

Dopplerography provides the opportunity to examine blood vessels and diagnose the level of vascular disorders , which in turn allows for blood flow assessments and differentiation of the stages of the pathological process in the hip joint.

One of the most popular diagnostic methods is densitometry, which allows us to determine the full picture of the state of the IPC and makes it possible to determine the tactics of surgical treatment. Clinic ANFH is characterized by the first signs are minor pain in the hip joint and gait disturbance due to pain. Diseases, navigate the stage and also the choice of treatment methods.

ANFH has certain degrees and depth of damage. This disease develops gradually and has no definite boundaries and periods smoothly pass from one to another.

In the absence of effect from conservative treatment, surgical methods of treatment were used. The most effective minimally invasive method is neuroablation of the initial stage of this disease, and at stage IV , hip joint endoprosthetics, which allows achieving a good result in a short time.

Based on the analysis of literary data, we can say that it is necessary to conduct research work to improve the choice of methods for treating ANFH, which is still an urgent problem in traumatology and orthopedics. The purpose of this study was to improve the results of treating patients with aseptic necrosis of the femoral head, taking into account the severity of the disease by conducting complex treatment and rehabilitation of patients.

The work is based on observation of 259 patients with ANFH: stages I-II in 195 patients and stages III-IV in 64 patients. The patients were hospitalized in the department of orthopedics and consequences of injuries of the Bukhara regional multidisciplinary center, a private clinic in the city of Bukhara “ StarOrthomed ” , in the period from 2015 to 2021. Among our patients, patients aged 45-55 years prevailed. ANFH occurs mainly in middle-aged and older patients. Among our patients, men prevailed - 171 (66%). In carrying out our work we used X-ray, MRI, Doppler, ultrasound and densitometric studies.

Upon admission of patients, clinical examinations began with the collection of complaints, a detailed anamnesis of the disease, an objective examination of the general and local condition, as well as past illnesses. All patients had pain in the hip joint area, limited or, in some patients, no movement in the joint, shortening of the limb, a gradual increase in chromatism of the lower limb, and hip joint contractures were also observed. Most patients noted non-simultaneous, joint damage. In some patients, one patient observed different degrees of clinical signs.

Patients with ANFH were clinically **characterized** using a computer program developed by us, which took into account the intensity of pain, joint mobility, and the ability to walk. Clinical signs such as pain, which gradually increases over the years, mobility, and limitation of movement in the hip joint with ANFH depend on the stage of the disease. Upon admission of patients, a functional study was assessed using 6 clinical parameters on a 5-point scale; the clinical outcome was assessed by analyzing the sum of the scores.

Good was in the range from 15 to 22 points, satisfactory - from 8 to 14; unsatisfactory was assessed by a sum from 0 to 7 points. We assessed the functional state of patients with ANFH in 259 patients of different stages. We divided the patients into two groups, the main 171 (67%) and the control 88 (33%). We assessed the functional state of patients after hip arthroplasty for ANFH III - IV stages which in turn were divided into the main 44 (66%) and control 20 (34%) groups.

We have studied radiographic data in all patients with ANFH from 2015 to 2021. In case of the disease, radiography of the hip joint makes it possible to determine the area of bone tissue compaction, as well as changes in the joint space and the presence of enlightenment and the appearance of destruction of the femoral head.

In case of ANFH, the X-ray of the hip joint is of great importance. The stages of the disease quickly pass into one another during progression and it is impossible to accurately differentiate the stages of the disease. In practice, it is necessary to divide the stages of the disease based on X -rays and MRI. X-ray examination makes it possible to determine ANFH at early stages and the method of treatment.

With the help of ultrasound Doppler examination, the condition of blood vessels is increasingly determined. This method is distinguished by its relatively low cost, simplicity, dynamism, and safety of the study, which determines a wide range of ultrasound characteristics of the area being studied using Doppler ultrasound examination, early signs of ANFH can be identified, and progression of the disease can also be identified in the area of osteonecrosis in the form of avascularization of the zone, and in the last stage, vascular destruction can be determined, in which the appearance of pathological vessels is noted.

The safety of the method makes it possible to conduct multiple studies and provides an opportunity to track the results of the treatment. Dopplerographic methods of study were carried out on the common femoral artery (CFA), superficial femoral artery (SFA) and deep femoral artery (DFA) and similar veins of the thigh of the examined patients. For comparison of the indicators, Dopplerographic results of 22 healthy patients were taken.

Dopplerographic methods of research were carried out in 45 patients in the ultrasound Dopplerography room with the help of a specialist in the preoperative period, in the postoperative period after 10 days, in dynamics in 3 and 6 months after the operation. During the study it was revealed that the walls of the common and superficial vessels of the femoral arteries were thickened, and the intima was compacted. The lumens of the common and deep femoral arteries are passable, and the main blood flow on the right is not changed. In the left lower limb, the peripheral resistance in the arteries was increased, which shows a blood flow deficiency in the hip joint on the right.

MRI is the most useful, non-invasive method in diagnosing ANFH, the best method for determining the indication for surgical treatment. Based on MRI examination, it is possible to identify 4 stages of femoral head damage. MRI examination is the best and objective method for determining the indication for conservative and surgical treatment. Thus, MRI data of the hip joint in ANFH allows you to objectively assess the condition of the ligamentous apparatus of the joint, cartilaginous surfaces and observe the effectiveness of conservative and surgical therapy.

In ultrasound densitometric examination of patients with ANFH, bilateral coxarthrosis with ANFH and adduction contracture stage III, sclerosis, deformation of the femoral head and the presence of subchondral cysts are observed and a decrease in the BMD of the limb on the affected side (T-score and Z-score on average = -2.0) was revealed in 64.5% of cases. Stage IV with partial and complete fibrous fusion of the joint, which was more often observed at the age of 55-66 years (T-score and Z-score on average = -1.6) in 78% of cases.

Analysis of the densitometry results showed that the level of decrease in BMD before treatment was noted to be sharply reduced depending on the depth of the femoral head lesion, then after treatment it increased depending on the patient's activity, i.e. gradual development of the hip joint and the patient's walking. Thus, in 12 of 24 patients with stage 4 of the disease, a decrease in BMD T-score and Z-score below -1.6 was observed.

Thus, we noted that statistical analysis of the obtained densitometric data between groups of severe stages of the disease revealed a decrease in the BMD accordingly with increasing age, duration and stage of the disease. This indicates that without a load on the NK, an increased decrease in the BMD is noted. After treatment, it increased depending on the patient's activity, i.e. gradual development of the hip joint and the patient's walking. Thus, ultrasound densitometry allows us to assess the state of the BMD in patients with ANFH. A decrease in the BMD and the presence of osteoporosis provides opportunities for choosing the tactics of further treatment.

We have conducted modern methods of treatment for ANFH in 80 patients with platelet-rich plasma (PRP) at stage 1-2 of the disease by intra-articular administration of PRP. PRP contains alpha granules of platelets with a growth factor. Which gradually goes into the surrounding tissue, they improve regeneration or the reparative process of action on inflammation. Thanks to this powerful autococktail, the maximum effect is achieved to relieve inflammation, improve regeneration, stimulate local immunity and increase local blood supply. The data obtained when administering PRP is ambiguous in its judgment depending on the results and the stage of the disease. The results of treatment in 101 patients with ANFH were studied.

Recently , a modern new innovative method has been used for severe pain syndrome against the background of ANFH (ablation). The method of radiofrequency neuroablation (RFA **) is** used to reduce pain in the hip joint and knee joint, as well as when it is impossible to replace the joint. Ablation (denervation of sensory nerves) is a new, simple and more effective method of treatment. RF denervation of sensory nerves - for ANFH in the hip joint. The most widely used method is RF ablation (RFA) of the obturator and femoral nerves in osteoarthrosis of the hip joint and knee joint without surgery.

painkillers . Since patients have systemic diseases, severe concomitant pathology and there are restrictions on performing hip joint endoprosthetics, in such cases the RFA method can be used. This method was used in 94 patients. three main symptoms: pain, mobility, and the patient's walking. The average observation period with remote results ranged from 6 months to 1 year; the treatment results were assessed using the W. Oberg scale. These features were divided into 3 categories: they were assessed at 11 and 12 points each.

To assess the functional state of patients before and after treatment, neuroablation was performed using the method we developed (from 0 to 7 in ascending order, that is, from the absence of pain - 11-12 points, to severe and constant - 0 points):

- the degree of mobility of the hip and knee joint was assessed as normal more than 90 degrees, with abduction up to 30 degrees - 11-12 points to ankylosis in a vicious position - 0 points;

The assessment of the walking condition was assessed from 11-12 points, when the patient could not walk - 0 points. Summing up the points by parameters - pain, mobility, walking, the results of the functional state of the hip and knee joints were assessed. The result of the sum of points 11-12 was assessed by us as very good, 10 points - good; 9 points - average; 8 points – mediocre ; 7 points or less – bad. We have obtained good and very good results, when patients had no pain in the joints when walking and at rest, we also took into account the increase in the amplitude of joint movements and normal walking. In patients with ANFH, we noted an improvement in the results after 1 month - in 85.8%, after 3 months - in 88.3%, after 6 months - in 82.0%, after 12 months - in 78.9%. We noted remission of the disease for up to one year. Unsatisfactory results were observed in 2 (2.6%) patients with ANFH stage IV, who required surgical treatment, i.e. endothesis of large joints due to the presence of concomitant diseases. Neuroablation is the method of choice when conservative treatment methods are ineffective, relieves pain and thereby alleviates the patient's suffering.

Of the patients studied, 64 underwent hip replacement, of which 55 patients underwent cementless replacement. The patients were divided into 2 subgroups: the main group (40 patients) and the control group (24 patients). During the replacement, endoprostheses of various designs from foreign companies were used.

We studied the quality of life of patients using a scale developed We examined patients before and after treatment in all 259 patients. The patients were of working age from 20 to 65 years. In this system, 6 clinical parameters were used on a 5-point scale, the clinical result was assessed by analyzing the sum of points.

Good was in the range from 15 to 22 points, satisfactory - from 8 to 14; unsatisfactory was assessed by a sum from 0 to 7 points , before the operation, that in patients with ANFH before the operation, pain was noted - in the main group 1 point, in the control group 1 point. After the operation, after one month, it became 2.5 points in the main group and 2 points in the control group. Before the operation, patients had a violation of the mobility function of varying severity . After the operation, the dysfunction was restored; before the operation, 1.5 points were noted in the main group and 1.5 points in the control group. After the operation, one month later, it became 2.5 points in the main group and 2 points in the control group.

Before the operation, patients had emotional perception in the main group it was 1.5 and in the control group it was also 1.0 points. After the operation, after one month, it became 1.5 points in the main group and 1.5 points in the control group . Before the operation, patients needed rehabilitation and support means (orthoses, cane) in the main group it was 1.5 and in the control group it was also 1.0 points. After the operation, after one month, it became 2.5 points in the main group and 2.5 points in the control group. Before the operation, patients had little ability to walk, perform actions with the upper limb before the operation in the main group was 1.5 and in the control group also 1.5 points. After the operation, after one month, it became 2.5 points in the main group and 2 points in the control group. Before the operation, patients had the ability to lift and carry weights . Before the operation, the main group had 1.5 points and the control group also had 1.0 points. After the operation, after one month, the main group had 2.5 points and the control group had 2 points.

The average score before treatment was 8 in the main group and 7 in the control group. After treatment, it was 14 in the main group and 12 in the control group. The presence of constant pain was the main indication for surgery in both groups; after surgical treatment, pain decreased most in the main group compared to the control group, which shows the good effectiveness of surgical treatment of hip joint.

We present comparative results of treatment in patients with ANFH after treatment after 3.6 months and one, Two years after the operation, pain was noted in patients in the main group: after 3 months - 3, 6 months - 3.5, 1 year - 4 and 2 years - 4 points. In the control group: after 3 months - 2.5, 6 months - 3.0, 1 year - 3 and 2 years - 4 points. After the operation, the functional impairment was observed in the main group: after 3 months – 3, 6 months – 3.5, 1 year – 4 and 2 years – 4 points. In the control group: after 3 months – 2.5, 6 months – 3.0, 1 year – 3 and 2 years – 4 points. After the operation, patients had an emotional perception in the main group: after 3 months - 3, 6 months - 3.0, 1 year - 3 and 2 years - 4 points. In the control group: after 3 months - 3.0, 6 months - 3.0, 1 year - 4 and 2 years - 3 points. After the operation, patients needed rehabilitation and support means (orthoses, cane) in the main group: after 3 months - 3, 6 months - 3.5, 1 year - 4 and 2 years - 4 points. In the control group: after 3 months - 3.0, 6 months - 3.0, 1 year - 4 and 2 years - 4 points. After the operation, the patients had the ability to walk, perform actions with the upper limb, emotional perception in the main group: after 3 months - 2.5, 6 months - 3.0, 1 year - 3 and 2 years - 3 points. In the control group: after 3 months - 2.0, 6 months - 3.0, 1 year - 2.5 and 2 years - 3 points.

After the operation, patients experienced gait disturbances and the ability to lift and carry heavy objects . In the main group: after 3 months – 2.5, 6 months – 3.0, 1 year – 3 and 2 years – 3 points. In the control group: after 3 months – 2.0, 6 months – 2.0, 1 year – 2.5 and 2 years – 3 points. The average score before treatment in the main group: after 3 months - 17, 6 months - 20.0, 1 year - 21 and 2 years - 22 points. In the control group: after 3 months - 15.0, 6 months - 17, 1 year - 19 and 2 years - 21 points. From these data we can say that in the postoperative period, after 6 and 12 months, patients show an improvement in treatment results: a decrease in pain, deformation, an increase in the range of motion of the joints and an improvement in limb function.

In 259 patients with ANFH, good results were obtained in the main group in 167 (65%), in the control group 46 (18%). Satisfactory in the main group in 24 (9%), in the control group 18 (7%). Unsatisfactory in the main group in 1 (0.3%), in the control group 3 (1.0%).

Thus, the indicators of good treatment results in the main group show the effectiveness of our treatment method in comparison with the control group.

Conclusions.

1. The developed program for a comprehensive assessment of the condition of patients with aseptic necrosis of the femoral head, taking into account the clinical manifestations and functional characteristics of the disease, allows choosing the optimal method of treatment.

2. The use of plasma lifting in ANFH helps to reduce the inflammatory reaction of soft tissues and improve cartilage regeneration with normalization of the function of the hip joint, which leads to early activation and rehabilitation of patients and longer remission of the disease itself.

3. The use of the neuroablation method in patients with ANFH promotes an effective reduction in pain sensitivity and a decrease in muscle spasm, which improves joint function, which allows postponing hip replacement surgery .

4. The use of the proposed surgical instrument " raspatory " used during hip replacement surgery for ANFH facilitated the performance of the surgical operation with a reduction in the duration of the operation and a decrease in postoperative complications.

5. The use of the developed method of hip joint endoprosthetics in ANFH against the background of severe osteoporosis contributes to good integration of the prosthesis with the bone, leading to an improvement in the functional capacity of the joint and an extension of the service life of the endoprosthesis. and also improves the quality of life of patients.

6. The use of the spherical head of the hip joint endoprosthesis developed by us allows for an increase in structural strength and operational reliability of the implant.

7. The use of the developed method of surgical treatment of patients with ANFH led to an increase in the effectiveness of the postoperative course: the proportion of treatment results assessed as "good" increased to 95%; and the proportion of " unsatisfactory results" decreased by 2.5%.

LIST OF SYMBOLS

ANFH - aseptic necrosis of the femoral head

PRP - plasma lifting

TB C - hip joint

K C- knee joint

FT – femur

CT – computed tomography

RFNA – radiofrequency neuroablation

PSV – peak systolic velocity

RI – resistance index

PI – pulsation index

OBA – common femoral artery

SOS – speed of conduction

BMD – bone mineral density

T-2 – MRI mode

T-1 – MRI mode

SFA – superficial femoral artery

DFA – deep femoral artery

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